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DECLINE OF THE U.S. ELECTRONICS INDUSTRY

HEARING

BEFORE THE

SUBCOMMITTEE ON SCIENCE, TECHNOLOGY, AND SPACE

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

ONE HUNDRED FIRST CONGRESS

SECOND SESSION

ON

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AUGUST 1, 1990

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DECLINE OF THE U.S. ELECTRONICS INDUSTRY

WEDNESDAY, AUGUST 1, 1990

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
SUBCOMMITTEE ON SCIENCE, TECHNOLOGY, AND SPACE,
Washington, D.C.

The subcommittee met, pursuant to notice, at 9:.34 a.m., in room SR-253, Russell Senate Office Building, Hon. Albert Gore, Jr., [chairman of the subcommittee] presiding.

Staff members assigned to this hearing: Pat Windham, professional staff member; and Fiona Branton, minority staff counsel.

OPENING STATEMENT BY SENATOR GORE

Senator GORE. The hearing will come to order.

I would like to welcome our witnesses and our guests to this hearing on a subject of vital importance, the future of the U.S. electronics industry. As we meet today, official Washington has reached an impasse in the debate over how to promote industrial competitiveness and long-term economic growth.

Despite overwhelming evidence of industrial problems, and despite the efforts of many in Congress and in the Commerce Department, the White House stubbornly refuses to acknowledge that America's industries and standard of living and economic future are in jeopardy.

In fact, this same White House is actively helping the competition. Last Saturday, incredibly, the President approved Japan's proposed purchase of Semi-Gas Systems, an acquisition that would give the Japanese a near monopoly on the very pure gases required to make advanced semiconductor chips. The purchase would also seriously hurt SEMATECH, the industry/government research consortium which invested heavily in Semi-Gas, and which must now spend six months and up to $100 million to develop a domestic alternative.

That particular issue is not yet completely settled, since the Justice Department must conduct an antitrust review of the proposed purchase. But people concerned about the purchase are not holding their breath for the Justice Department to reverse the White House's misguided decision. The headline in the "New York Times" on this purchase I thought summed up the attitude of the White House: "Bush to Let Japanese Buy Concern Vital to Chip Race."

While other nations consciously promote the key industries and technologies of the future, this administration ignores new global realities, lets competitors grab companies that have been carefully nurtured with U.S. taxpayer dollars, and fires those government officials who dare to speak out. As a result, real progress on the competitiveness issue is agonizingly slow.

Given this situation, what is the best course of action for those of us concerned about the Nation's industrial strength and economic growth? What strategy can we develop to give our industries a fighting chance?

I hope that this morning's hearing can help us address these questions and make a contribution toward a new national strategy for the electronics industry.

I particularly want this hearing to do two things. First, I want to step back for a moment and assess exactly where our electronics industry stands. Because some people say from time to time, well, you can get overly concerned if you just look at a key strategic acquisition by Japan, a key abandonment by the White House of our own policy. What about the longer term picture? Can we not take a more dispassionate view?

Well, luckily, we have two new reports that have done exactly that. And we are going to discuss them today. From both reports, we know that the current outlook for the U.S. electronics industry, unfortunately, is not good, whether you take a long-term view or a short-term view, or whatever view you take. Both the report from the Commerce Department and a study released last week by the Computer Systems Policy Project show an industry characterized by declining market shares, levels of investment which simply do not match those of Japan, growing dependence on foreign components, and increasing sales of some of its best, small high-technology firms to foreign competition.

Secondly this morning, I want to ask what actions industries and government should take to reverse this decline. In light of the scandalous Semi-Gas case, I want to ask what specific steps would be most useful and effective. We all know the big policy issues, capital costs that are twice Japan's, a failing U.S. educational system, inadequate Federal investment in civilian research and development, and continued foreign trade barriers.

This morning we certainly will discuss all of these issues as we address the questions on our agenda. But while we are working on these long-term problems, are there also other steps we can take now to improve the industry's competitiveness? There are a number of ideas in circulation worthy of our attention and debate. For example:

First, whether current reviews of proposed foreign acquisitions should be extended to cover economic security considerations, as well as military security. The Bush administration, of course, fought against that, but now, looking at what they have done with Semi-Gas, I think the time is ripe to reopen that question.

Secondly, whether Charles Ferguson of MIT is right when he says that the fragmented U.S. electronics industry should form new internal alliances and create American versions of Japan's powerful keiretsu conglomerates.

And three, whether industry and government should together expand the number of U.S. research consortia, and also expand the concept by creating one or more test bed programs to test and speed the introduction of new manufacturing equipment.

Luckily, this morning, we have a distinguished set of witnesses to discuss these issues and these ideas. Dr. Robert White is not only the Under Secretary of Commerce for Technology, but also an experienced computer industry executive.

Dr. Samuel Fuller is the highly respected head of research at Digital Equipment Corporation, and this morning will present the findings of the new report from the Computer Systems Policy Project.

Peter Mills is SEMATECH's Senior Vice President for Administration, and one of the individuals who has been most deeply involved in the discussions of the proposed sale of Semi-Gas to the Japanese.

Mitch Kertzman is an entrepreneur and President of the American Electronics Association. Louis Perrone runs a semiconductor materials firm in California and today represents Semiconductor Equipment and Materials International, the trade association for that particular part of the electronics industry.

Gentlemen, I want to welcome all of you. And as we start this hearing, I want to pledge to you again this Subcommittee's continuing and sustained interest in working with you to develop an effective national strategy for keeping the U.S. electronics industry strong and competitive.

I think it will be most productive to have all of the witnesses this morning appear as a panel. And after you have all concluded your statements, I will ask each of you very briefly to comment on any aspects of the other presentations which you would like to have the subcommittee consider in a somewhat different light.

If you feel that some of your fellow witnesses have overstated something or understated, or misstated something, I am sure you would not directly challenge each other, but we want to encourage you in case that you will. Because it is one way to get down to a deeper level of meaning. So, bear that in mind as you listen to each other's comments.

We will begin with Robert White, Under Secretary for Technology, Department of Commerce.

Without objection, your statement and those of all of the witnesses this morning will be included in full in the record. If you care to summarize any portion of your statement, feel free to do so.

STATEMENT OF DR. ROBERT M. WHITE, UNDER SECRETARY FOR TECHNOLOGY, DEPARTMENT OF COMMERCE

Dr. WHITE. Mr. Chairman, I am delighted to have the opportunity to share my thoughts with the subcommittee on the competitiveness of the U.S. electronics industry. The International Trade Administration's recent report on the competitive status of the U.S. electronics sector and my own Technology Administration's recent report on emerging technologies both describe an industry that, to borrow a title from Jean-Claude Derian's recent book, is struggling for leadership.

ITA's report, which was not formally cleared by the administration, demonstrates the danger of complacency, that while our electronic sector may be number one today by such measures as output, innovation and employment, the trend lines tell us something ELSE. that its growth rate in terms of production is the smallest of the major producers; that its market share declined in 32 of 37 electronic product categories from 1984 to 1987; and that in whole areas such as consumer electronics and dynamic RAMs we have only now a shadow presence.

The Technology Administration's report demonstrates that we are behind Japan today in four of the five electronics-related emerging technologies and losing ground. Indeed, we are falling behind Japan in 10 of the 12 key technologies that by the year 2000 could result in a $1 trillion market.

My own experience tells me that these reports are describing it as it is. As you have noticed, I have spent a good part of my professional life in research connected with peripheral devices for storing data. When I started my career, we were preeminent in this area. The U.S. pioneered video recording, the computer core memory, microwave components and the disk drive itself.

Since then I have watched our market share in floppy disks shrink to zero. Our share of hard disk drive is steadily eroding. Once strong research efforts in magnetics at major private sector labs have disappeared, and the U.S. is totally unprepared to compete in the new optical storage area.

What has led to this situation? The risks and costs associated with technology development and commercialization are enormous and escalating rapidly. The technologies are complex and multidisciplinary. Few corporations can go it alone. Some estimate, for example, that it will cost $6 billion to develop the 64 megabyte dynamic RAM.

Although R&D is generally considered a good investment on a national scale and some give it a rating of something like a 27 percent return, for individual companies the return may be too far in the future or the benefit may accrue to others in the meantime. More and more companies are investing less and less in R&D. In 1989 American industry's investment in R&D actually declined for the first time in 15 years. Furthermore, R&D is very sensitive to business downturns. When a company faces a difficult quarter, it is generally research that is the first to be cut.

In addition, the nature of the competition and the competitors is changing. 95 percent of U.S. industrial electronics companies have assets of $10 million or less. Individually, it is hard to see them as equal competitors with the vertically integrated industrial financial giants of Japan who can afford to be patient and spread their risks across a broad product portfolio.

Now as you noted, at one level there are certainly a number of macroeconomic actions that we can and should take to address the situation such as reducing the deficit, a permanent tax credit for R&D and reducing the capital gains tax. Indeed, current budget negotiations must succeed if capital costs are to be brought in line with that of Japan which, according to the ITA report, enjoys a 3 to 1 capital cost advantage, although some feel this may be on the high side.

Of course, we must focus on education and human skills, not just to make sure that we have the necessary number of scientists and engineers but to make sure that we have a general work force that can handle complex technologies.

When I took this position as head of the Technology Administration two months ago, I asked myself what we could do to make a real difference. First, I think there should be a consensus on just what are the critical technologies of the future. We must understand the factors that affect our competitiveness in those technologies. Only then can we make sound technology policy decisions. Studies such as our emerging technology report and DOD's critical technologies report help meet this need.

I currently sit on the President's National Critical Technologies Panel which is attempting to define a set of technologies critical to our national security and our economic competitiveness. Private sector studies such as the Computer Systems Policy Project on key factors that determine success in the computer industry also contribute to our understanding of these complex issues.

There are additional steps that reflect changes in attitudes and flexibility about new ideas. Not long ago, government made a simple distinction between basic and applied research. Applied research was not something that government should support unless we needed it for a Federal purpose such as a weapons program.

President Bush's speech to the American Electronics Association in March, however, coupled with the administration's decision to support our Advanced Technology Program reflect a new awareness that government must be a partner with industry in developing generic technology or technology in the precompetitive stage.

We have had a tremendous interest on the part of industry in our program. Not long ago, government laboratories acted as if cooperation with commercial interests was alien to their mission. Unlike NIST, which is the only Federal laboratory established expressly to serve industry's interest, most labs were

separated from industry by their own institutional Berlin Wall. That is not the only wall that has come down in the past year. Today the Technology Administration oversees a thriving Federal technology transfer program involving 400 new cooperative R&D agreements between the Federal labs and the private sector. A little over a week ago you and I, Mr. Chairman, took part in the signing of one of these agreements with DOE.

What the current issue of "Business Week" calls the Technology Administration's "small band of technoids" can do more.

Specifically, my goal is to see that our energies are devoted into a four-pronged offense:

First, to accelerate the commercialization of Federally-funded R&D and to remove obstacles to private sector R&D commercialization efforts;

Second, to encourage strategic partnerships among industry, the universities and government;

Third, to facilitate the introduction of advanced manufacturing technology, especially by small and medium size companies; and

Fourth, to insure that domestic and international S&P policies are properly integrated.

As to technology commercialization, we have a series of informal and technical assistance programs aimed at transferring technology and know-how to American business.

In addition to the ATP program and Federal technology transfer programs, our Clearinghouse for State and Local Initiatives in Productivity, Technology, and Innovation provides us with the potential for a coordinated network of Federal and State activities in the critical technology areas. The States, interested as they are in local and regional economic development, are eager to assist industry, and I hope to leverage that desire. I also see the community colleges as an untapped resource.

As to strategic partnerships, the Technology Administration plans to convene workshops in the critical technologies to encourage industies to begin to develop a consensus on their technological needs and to explore appropriate cooperative activities that will better equip them to compete against large diversified, vertically-integrated competitors.

As to advanced manufacturing, there is no question that we must stimulate the adoption of advanced manufacturing technologies throughout industry and foster a commitment to quality.

I believe manufacturing is an essential part of the technology commercialization process. It is not something that can be done in isolation from the research, design and development. I believe that if we forfeit the ability to manufacture, we put the whole technology infrastructure at risk.

The manufacturing problem in the United States is very deep rooted, and it is the legacy of conditions that existed at the turn of the century which had led to a very inflexible system. We must change our manufacturing paradigm if we ever hope to take advantage of the new manufacturing technologies.

Our Automated Manufacturing Research Facility, our Manufacturing Technology Centers, and our Shared Flexible Computer-Integrated Manufacturing Program are all geared to demonstrating the power of advanced manufacturing and getting it into the hands of American business. The Baldrige Quality Award complements those efforts.

On a related matter, we plan to work with the financial community to encourage the adoption of accounting standards that are compatible with advanced manufacturing practice.

Lastly, we need to remember that technology issues do not stop at the water's edge. Secretary Mosbacher has made the Technology Administration the Department's international science and technology coordinator. In that role, we seek to insure that we have access to Japanese technical literature, that our bilateral S&T relationships are indeed symmetrical, and that our interests are properly represented in international standards organizations which is a matter of increasing concern as EC '92 approaches.

Taken in total, these programs, which range from internal research to grants to outreach efforts and that will link together industry and Federal labs and the States within the unifying context of the critical technologies, represent an enormous opportunity to reverse the trends in electronics that concern us all.

Thank you.

[The statement follows:]

STATEMENT OF DR. ROBERT M. WHITE, UNDER SECRETARY OF COMMERCE FOR TECHNOLOGY, DEPARTMENT OF COMMERCE

Mr. Chairman and members of the subcommittee, I am delighted to have the opportunity to share my thoughts on the competitiveness of the U.S. electronics industry.

You have requested that I address several topics: a recent Commerce Department report regarding the long term competitiveness of the electronics sector, the U.S. electronics industry's particular weaknesses and vulnerabilities, and specific steps that government and industry can take to ensure continued U.S. leadership in electronics.

In my opinion, the report on this subject prepared by Commerce's International Trade Administration does an excellent job of laying out the facts. I want to note that the report should be read as representing the Views of the Commerce Department. It does not necessarily reflect the, views of the Administration, nor did it receive interagency clearance.

The report emphasizes, and I believe, that the electronics industry is "struggling for leadership", to borrow from the title of Jean-Claude Derian's recent book on American technology. What concerns me most in this report are the stated estimates of the rates of change. The U.S. is first in the volume of electronics production, but at this time our growth rate is the smallest of the major producers. U.S. market shares decreased in thirty-two of thirty-seven product categories in electronics from 1984 to 1987. In whole areas, such as consumer electronics and DRAMs, there is no longer a large U.S. presence.

To me, this indicates that we are not operating on "all cylinders." We are technologically dominant yet we are losing markets to the competition. In my view, that means the efficiency and effectiveness of our technology commercialization process leaves a lot to be desired.

My perspective on our competitiveness in electronics is strongly influenced by my own experiences. Woven through the Commerce report are statistics on the Peripheral devices for storing data: the U.S. market share in floppy disks is Very small, our share of hard disk drives appears to be eroding, and I believe we are completely unprepared to compete in optical storage. This is the technical arena in which I have spent most of my career. When I entered this field, U.S. strength was unquestioned. We Pioneered video recording, the computer core memory, microwave components, and the disk drive. Today there are really only two universities in the U.S. that offer courses in this area; the once strong research efforts at Bell Labs, G.E., and Westinghouse, no longer exist. Yet the recording market today is almost twice the size of the semiconductor market—about $56 billion.

The Commerce report amply demonstrates the role of the U.S. electronics industry in the U.S. economy in terms of shipments, productivity, exports, employment, and innovation. The value of electronics exports exceeds that of aircraft, automobiles, textiles and wood products combined. Electronics employs almost a tenth of the manufacturing work force. It is the leading industry in innovation, measured in terms of Patents granted. In short, it is, in my view, the source of Products and services that are essential for the long-term health of the manufacturing, defense, and service sectors.

And, finally, it is a major source of new firm creation, particularly smaller firms that are often the key sources of innovative new technologies But its importance and current strengths notwithstanding, I clearly see some problems ahead.

Although the U.S. electronics industry is generally acknowledged to be the world's largest, its growth rate in terms of production since 1984 is the lowest of the eight world competitors that account for almost all of the world's electronics manufacturing—namely the U.S., Japan, Korea, Taiwan, Singapore, India, Brazil, and the EC. The report concludes that if Japan and the U.S. maintain their respective growth rates, Japanese electronics production will surpass that of the US before the end of this decade. This projection is of course based on the assumption that U.S. industry does not change its business practices. Only time will tell if that is a fair assumption, given that the competition is so

intense. The Technology Administration's recent study, "Emerging Technologies: A Survey of Technical and Economic Opportunities," also provides a troubling prognosis. "Emerging technologies" have the potential to create important new products and industries, and to substantially improve Productivity or quality for existing industries. They are also the ones that will drive the next generation of R&D and spin-off applications

Of the twelve emerging technologies identified in the Emerging Technologies Report, five relate to emerging electronics and information systems: advanced semiconductor devices, digital imaging, high-density data storage, high performance computing, and optoelectronics. The Report finds that at this time we are behind Japan in most of these and even with or ahead of Europe. But it also finds that the trend is ominous: that against Europe, we are just holding our own; against Japan, it concludes that we are losing ground and in some cases, such as superconductors and digital imaging technology, we are losing badly.

Figures on world trade share, production, or qualitative assessments of the state of our technology base tell only part of the story. Our electronics industry is operating in a dramatically changed environment in which globalization, interoperability, and lightning-quick technological advances impact not only its success but its survival. Today, as observers such as Charles Ferguson of MIT and Kenichi Ohmae of McKinsey and Company have noted, the pace of digitization is proceeding so rapidly that many of the same electronic devices are used in unrelated products such as cameras, automobiles, computers, stereos, robots, and photocopiers. For example, the charged-coupled device is used in home video cameras, optical character readers used in offices, and in factory automated vision systems. What were once distinct areas of electronics— home, office, and factory—are now becoming fused together by their common electronic components.

At the same time, the electronics industry is becoming increasingly dependent on foreign manufacturers for components, subsystems, equipment, and even entire systems. And this problem may not be exclusive to the U.S. Companies that are able to manufacture standard, state-of-the-art high quality, electronic components in large volumes at competitive prices are well-positioned to take advantage of this technological trend.

There are several other important characteristics of the emerging electronics and information systems arena that demonstrate potential problem areas in technology and financing.

The complex, multidisciplinary nature of these technologies, as well as the need to establish facilities, often makes it prohibitively expensive for even large corporations to go it alone. Investment requirements can exceed hundreds of millions of dollars.

The potential benefits from many of these technologies transcend the scope or product portfolio of most U.S. corporations. Thus, facing high costs with limited applications for the technology, many individual firms cannot reach sufficient economies of scale to justify the investments.

Bringing products and processes based upon these technologies to the marketplace quickly enough to achieve a competitive position may require simultaneous advances and cooperative efforts in basic research, design, and marketing. The manufacturing, private sector may find it useful to mobilize many scientific and technological disciplines, many industries, and large financial resources, actions presenting unprecedented management challenges. Let me emphasize that the private sector, not government, must make these decisions and that they will remain fully subject to antitrust scrutiny.

It is illustrative to examine our most formidable electronics competitor, Japan, which is beginning to be emulated by other Asian and European nations. The Japanese electronics firms are often large, diversified, and vertically integrated. They can spread high R&D costs over a large and diverse product base reducing the financial exposure and risk in technology ventures. They are well Positioned to capture any "economies of scope" or the multiple applications of electronics and information systems technology. Their system of interindustry and interfirm cooperative relationships, including vertically integrated networks under common control, allow the introduction of new electronics components simultaneously in many different applications and markets.

Involving multiple stakeholders activates the interdependency among upstream and downstream players. The firms can mobilize resources quickly, pool technical expertise, and share long-term risks. The downstream product lines provide a stable internal market for new products.

In the U.S. of the more than 16,000 industrial electronics firms, 95 percent are small and only have assets of less than $10 million. These firms are highly entrepreneurial and they have been a wellspring of innovative new technologies.

However, certain technologies require large investments that exceed the capabilities of most small firms. For example, the price tag for developing and commercializing the 64 megabit DRAM, which will hit the market in the mid-1990s, has been projected to exceed $6 billion. IBM will spend $1 billion pursuing X-ray lithography for semiconductor manufacturing. These costs exceed the resources of most U.S. firms invested. At the systems level, DEC invested $1 billion over six years on its new Vax 9000 main frame family.

In my view, competitors whose industries are more integrated may diffuse and assimilate electronics and information systems technologies in greater scale and scope and more quickly, outpacing us in product development cycles. Our research shows that Japanese firms generally introduce manufactured products twice as fast as U.S. firms. It is widely held that the Japanese have achieved such speed by integrating R&D, design, manufacturing and marketing through methods such as concurrent

engineering, total quality, and just-in-time production. This integration is present even if the various functions such as R&D or design or manufacturing take place in different firms.

Our smaller firms are especially vulnerable to cyclical downturns and to price competition from larger vertically-integrated foreign competitors who can afford to be more patient, take a longer-term view of the development cycle, and who can sustain a loss in a product line because their risks are spread across a broader product portfolio.

These characteristics are exacerbated by the fact that the Japanese enjoy what ITA's report estimated to be a 3 to 1 cost of capital advantage, although some observers believe this may be on the high side.

Against this backdrop, I would like to now offer both some general observations about possible industry and government responses as well as outline some initiatives underway in the Technology Administration.

The U.S. should not adopt the Japanese Keiretsu system, which can restrict competition. However, consistent with our antitrust laws, U.S. industries may wish to consider adopting those elements of foreign success that may help ensure their survival, and modify them to complement our culture, strengths, and our uniquely free enterprise system. Once again, let me stress that such decisions must be made by industry and industry alone - not by government.

Consistent with sound antitrust principles, we must permit companies and industries to explore new forms of collaboration and cooperation. Congress and the Executive Branch have already made some headway in removing unjustified barriers to industry cooperation. For example, Commerce took a leading role in the effort to pass the National Cooperative Research Act of 1984 which removed the major antitrust fears in cooperative R&D. To date, about 180 R&D consortia have registered under the Act. President Bush has proposed legislation to extend the Act's protection to cover joint production activities as well. As the President has explained, thais initiative will build on the competitive strength of American business by allowing firms to pool their skills, build new production facilities, and share investment risks.

Firms whose products depend upon electronics and information systems technology may wish to consider working together to find new and better ways to marshall the nation's unparalleled technological, entrepreneurial, and manufacturing assets on a scale necessary to meet these competitive challenges. Fundamental changes in corporate culture may warrant consideration, not just within firms but also in the ways firms work with each other. These changes cannot occur by government fiat. U.S. industry must select the forms of, and participants in, flexible, innovative cross- industry cooperative relationships.

Macro-level remedies relating to cost of capital, such as reducing the budget deficit, making the R&D tax credit permanent, reducing the capital gains tax, and President Bush's family savings plan, are also necessary. Indeed, current budget negotiations must succeed if our capital costs are to be brought down. Other macro issues, such as a recommitment to education, are also essential. However, the subcommittee has asked me to address more "micro" matters.

I believe that the Federal government can act as a catalyst and assist U.S. industry in meeting the challenges I have outlined today. The Technology Administration has a strategy for such support that focuses upon the transfer to the private sector of federally-funded R&D that may have commercial application; working with industry to reduce barriers to the commercialization of the results of private sector R&D; encouraging, where appropriate, strategic partnerships among industry, universities, and government; and introducing advanced manufacturing technology and practices, particularly to small and medium-sized firms.

We are now planning a major initiative to convene representatives of industry and their upstream and downstream partners These meetings will provide the forums through which industry, acting on its own, may choose to develop consensus on its technological needs and may consider appropriate cooperative activities. These are designed to allow industry to decide whether to move toward organizing and managing their technological, financial, and manufacturing resources on a scale that allows them to compete effectively with those foreign competitors that are large, diversified, and vertically integrated.

The Technology Administration's Advanced Technology Program Provides grants to individual companies or consortia of firms to develop pre-competitive generic technologies. The ATP emphasizes generic technologies that underlie a wide range of potential applications. By requiring cost sharing by consortia, the government leverages its investment. It is possible that we may receive a number of electronics- related proposals and these may give us insights into the dynamics of forming consortia.

The Technology Administration is also working to encourage new and Vital Partnerships between industry, universities, and government through several mechanisms.

Through cooperative activities, we are determined to realize commercial pay-off from the Federal government's huge R&D investment. The Technology Administration is responsible for overseeing efforts by federal agencies to implement the new laws and policies such as the Federal Technology Transfer Act which removed many of the barriers to transferring Federal technology to the private sector for commercial use. As you know, President Bush has requested a record $71 billion for R&D in FY 91.

There are now more than 400 new cooperative R&D agreements between Federal laboratories and U.S. industry. I might also mention that, from 1986 to 1989, Federal laboratory royalty income increased ten-fold.

To increase U.S. industry's awareness about the opportunities they can now access in the Federal R&D system, we have begun a technology transfer seminar series. At the first seminar, industry representatives learned about opportunities to collaborate with four Federal laboratories that conduct biotechnology R&D.

Many states have established programs to help businesses, particularly small and medium sized firms, commercialize new technology and improve their competitiveness. States, often in Partnership with universities, are organizing seed capital and product development funds, management and technical assistance, small firm incubator centers, research partnerships, and technical training programs. The Technology Administration's Clearinghouse for State and Local Initiatives on Productivity, Technology and Innovation is being designed to help states and industry learn about such programs and experiences.

And of course, we are developing partnerships with other Federal agencies to ensure that all appropriate Federal resources are brought to bear, in an integrated and coordinated approach, to support U.S. technological competitiveness. A primary vehicle for accomplishing this objective is through our active participation in the Federal Coordinating Council for Science, Engineering, and Technology and its various Committees. As you may know, The Commerce Department chairs the new FCCSET Committee on Technology and Industry.

The Technology Administration is committed to facilitating U.S. industry's efforts to improve its manufacturing operations so as to enable it to compete more effectively in world markets. For example, the experience of NIST in Providing infrastructure assistance that has effectively improved Productivity and quality in manufacturing is being brought to bear on electronics. The Technology Administration also provides information and expertise to small and medium sized firms in adopting automation techniques through several Regional Manufacturing Technology Centers.

We are also promoting a method to put the power of advanced manufacturing technology into the hands of small and medium-sized firms. Shared Flexible Computer-Integrated Manufacturing, or FCIM, is an automated manufacturing service center which uses off-the-shelf flexible manufacturing systems and leases manufacturing time to small firms. The shared centers are designed to help smaller companies that lack financing, manufacturing skills, and the technical capabilities needed to automate. Two centers are now operating, and 10 to 20 others are in Various stages of planning and development.

At Commerce, we believe that in order to reap the full rewards from automation, we need to automate the manufacturing process from design through production and marketing. The National Institute of Standards and Technology is working closely with the Computer-Aided Acquisition and Logistics program which improves the efficiency with which product data can be transferred and used within and between firms. Areas of emphasis include design and manufacturing, technical manuals, and logistic support.

The Technology Administration is also working with industry to examine how business accounting practices deter the adoption of flexible manufacturing systems. Commerce believes that standard accounting practices do not capture the benefits of advanced manufacturing technology such as flexibility improved quality, reduced manufacturing cycle times, reduced inventories, and the ability to introduce new products quickly. Because it is difficult to quantify these benefits, accounting standards inhibit equipment purchase justification. The Commerce Department has held several Financing Roundtables moving toward the goal of removing this investment barrier.

The problems and challenges facing the electronics industry face other industries as well. We at Commerce are ready to work with industry to ensure that it can meet the technology challenges of the 21st century.

Senator GORE. Thank you very much, Dr. White. If I may interject a comment, I appreciate your willingness to serve in the role you now have. I think you are personally doing a good job, but I must say that it has to be a lonely battle. I will not ask you to comment, but it is sad to see the few articulate voices within the administration silenced so frequently by ideologues within the White House.

I think President Bush is scared of the Japanese. I think he is scared to do anything that will make them unhappy because they are financing his fiscal policy, and I think that he is surrendering at key points along the way.

This decision on Semi-Gas—we will talk about it a little bit later—is really a true outrage. A true outrage. Here we have the U.S. taxpayers devoting millions of dollars to a Government/industry effort to organize a response to this incredible competitive challenge from the Japanese, and this consortium spends taxpayers' money on a small company to develop a key technology.

Then the Japanese come in and ask to buy that company with its key technology that the U.S. taxpayers have developed as a means of competing with the Japanese, and the consortium goes to the White House and says, surely you will not allow this? This is insane.

The White House says no, no, the Japanese want to buy it, so we are scared to tell them no, and then they put out a press release saying they are going to protect the key technologies without even consulting with SEMATECH about how that is to be done.

So in listening to your statement I heard kind words about the administration's approach and that is part of your job, too, but I did not want it to go unchallenged. But as I challenged it, I wanted to couple it again with admiration for what you personally are doing and your willingness to serve. I will give you a chance to comment on that as we proceed.

But let me move on, now, to Dr. Samuel Fuller, Vice President for Corporate Research at Digital Equipment

STATEMENT OF DR. SAMUEL H. FULLER, VICE PRESIDENT, CORPORATE RESEARCH, DIGITAL EQUIPMENT CORP

Dr. FULLER. Mr. Chairman, thank you for inviting me here today to testify in behalf of the Computer Systems Policy Committee, or CSPP as I will call it. As you know, it was formed last fall by a set of 11 CEO's from the computer systems industry to develop and then advocate a public policy agenda that will represent the view of our industry.

Rather than go through the 11 firms, I have provided a report to you and I think other people in the room which is our first technical report, or first output. On its cover, it lists the 11 firms and who their CEOs are. I will come back to this report in a moment.

As we are asking other people on the panel to comment on my testimony, I think it might be useful if I get copies of the reports and give them to other people on the panel here as well, because I will need to refer to several of the pages as we go through. So if we have some other copies, I would appreciate that.

Senator GORE. Do we have those?

Dr. FULLER. I thought you were going to be provided with those at the start here.

Senator GORE. Fine.

Dr. FULLER. If there are extra ones up front, maybe we could just bring three or four back to the people on the panel.

Senator GORE. Sure. Good idea.

Dr. FULLER. In getting started, let me simply mention three statistics, and then I will move into this report. First, if you look at the computer systems industry in 1989, the computer systems industry shipped $164 billion in hardware and software products and related services. In doing that, we employed 587,000 workers in the United States and about an equal number of workers overseas. We exported $22.4 billion in computer equipment, which I am told represents about 6 percent of total U.S. exports in 1989.

Now, in spite of these encouraging statistics, as the previous speakers have mentioned, we are seeing an erosion of some of our critical technologies and a loss in market share in a couple of the segments of the computer industry. For those reasons, this policy project, or computer systems policy project, was formed.

What I intend to do this morning is talk about the results of our first output, or first work, which is this report in front of you. Let me say that I think it is a significant report for a couple of reasons, the first being that this report represents

the first time the chief technologists of these 11 firms have gotten together on a series of occasions now, beginning in February, I believe, and developed a consensus as to what are the key technologies in our industry. I will describe those in a moment, but there was fairly good agreement as to what they were.

The second reason I believe the report is of real interest is that we went beyond simply identifying the 16 technologies and where we stood, but we also tried to describe what we saw as the critical success factors that would allow us to retain or regain our leadership in these areas.

So what I would like to do is, in fact, now describe to you these technologies and success factors. I have a chart here that we can just put up on the easel. Since I know the panel cannot see it, it is on page 7, I believe, in your report.

Senator GORE. You might actually turn that around so that our audience can see it. I cannot read it from here, and I will refer to page 7 of your report.

Dr. FULLER. All right, terrific. But they probably cannot see it either.

The working copy of this report was released last Thursday. Hopefully we can make more copies available to people in the room as the days go forward. But the things that I would like you to notice in this report are these on the left-hand side is the set of the 16 technologies that we have identified, and in the document itself it describes—it summarizes in a little bit more detail what we mean by each of these titles. We would be glad to talk about them later in the morning, if you would like.

Then across the top are the set of 15 potential success factors that we thought would be cross-cutting and important to these 16 technologies, and possibly others as well.

Now, with those set of technologies and success factors identified, what we have done in CSPP over the past number of months is, in each one of the member companies assess what our state in the technologies are and in addition what we saw to be the leverage from these various success factors.

CSPP has taken the inputs from those 11 companies. In this chart, on page 7, we have attempted in graphic form to summarize that, simply into strong, medium and weak leverage, and then the intent now will be to try and focus on those success factors that have the strongest leverage and begin to develop an agenda or advocate a set of public policies that will help enhance the important success factors here.

I guess what I will say at this point is, what we have concluded today, as I understand it, is how these success factors affect these technologies. The work in front of us for the remainder of 1990 is then to understand what public policy issues we would advocate or recommend to help enhance those success factors that we see as important.

Let me pull out of this chart those areas, or those success factors that we see as most important, cutting across these 16 technologies. While you just see them as red, green or yellow, I am going to go through them in the order that they came out in terms of importance. It may not be too surprising that the areas of capital investment and people and skills is on this list of six, but in fact the first factor, the most strongly-weighted factor, was making aggressive investments in research and developments, called "Applied R&D" on this chart.

So the ability for us to continue to make these investments, in our mind, came out as Number 1 in being able to stay at the front of all of these technologies. Second on the list, then, turned out to be people—the availability of high-quality, well-trained personnel. Mr. Chairman, I think in your remarks to us you characterized that as one of the macro issues, but it is right up near the top of our list.

Third was a focus on quality. Now, this often is a focus on manufacturing quality, but in fact for us to succeed here the intent is to have a focus on quality up and down the corporation, from research and development to manufacturing, to administration, to sales and service.

Fourth, and also very high on our list, was capital investment, or the ability to have patient, long-term capital to build our fabrication equipment and build the infrastructure required to have our industry move forward.

Fifth on this list of the top six items was state-of-the-art manufacturing, computer-aided design, flexible manufacturing, concurrent engineering and manufacturing.

Then sixth on our list of high priority items was basic research, and certainly in years past the U.S. has done well, both through Government and in industry, funding this, and we see this as continuing to be important in the years ahead.

Now, while these six came out on top of the set of 15, this is not to mean that the others are unimportant. As you read through the report, you can see how they factor across the set here.

But now, with that short introduction, I think the most useful thing I could do would be to try to both give you a little bit of insight into a couple of examples and then come to our four principal conclusions. So to try to give you a little bit more insight, I picked two of the technologies, one that we are not doing well in and one that we are, to give you some idea of what is going on.

On page 21—and I think we have a chart on it, as well—we show you one technology where things are not going well. It is in the semiconductor fabrication, or as this report calls it, the ULSI fabrication equipment and facilities.

On page 21 and on this chart you can see that we are well behind today, and the vector that goes from the circle in 1990 to the square in 1995 was the consensus view of the technologists as to what is likely to happen if we stay in our current trend of investments, which is, we will simply move from behind to being yet further behind.

We also said, if we could make an aggressive set of investments and if we had an environment in the U.S. that allowed us to make those investments both in research and development and manufacturing, where could we be in 5 years?

The triangle in 1995 was our assessment of what we might be able to do in a more favorable environment. Also, in the report we tried then to identify what were those high-impact success factors that could get us to the triangle in 1995 rather than the square.

This particular area is a capital-intensive area. The need for patient long-term capital is a requirement. Access to state-of-the-art manufacturing and a focus on quality is absolutely required, and continuing the applied research and development is essential. Some of those we are well- positioned to invest in ourselves as corporations. Some of those will need help from the country. But this is one example.

Let me go to the second example, which is processor architecture. This is probably the area that I am actually the most familiar with and have done the most work myself. In this area, you can see—and I am not sure of the page here, but—page 10 in your report. Today, the U.S. is clearly ahead, as it has been for some number of decades, and if you look at the trend that we are on, I would say without further enhancements in making the level of investment in R&D and basic research that we are in the process of making today and in the next several years, we will probably enter a situation where we still are doing well, but do not really have a real margin of lead over Europe and Japan and the rest of the world. Clearly with incentives to make yet more investments in basic research and

applied research and development, I think we have the potential to stay ahead in this area and have it continue to be an important area of strength for this country.

So what we have done in the report and take each of these 16 areas and do what I have just shown in these last charts: assess where we are today, where we are likely to be in 1995, and then an assessment of the technologists of if we are able to make more aggressive investments, if we had a more favorable environment for making those investments, where could we be in 1995, in that more optimistic scenario?

As I move forward, I am trying to find a way to summarize what we have learned from this report, and where we are headed in the months ahead. I come up with four comments.

First, that as these 11 companies have gotten together, we have realized that there are a number of challenges outlined in the report that we as companies need to address ourselves. Things such as a focus on quality up and down the corporation, and a focus on improving the manufacturing technology, we believe largely lies within our own hands to either succeed or fail at.

The second thing we see is that the U.S. is maintaining the competitive lead in those technologies that see a rapid rate of innovation, and have a focus on human factors, or interactions with person and machine, and are less capital intensive. Examples in this area are software engineering, the software application technologies, the computer processor architecture I have just described, as well as some of the computer systems architecture.

Enabling this country to continue to make strong investments in research and development we believe gives us the ability to maintain leadership in these critical technologies.

The third conclusion is that the United States now clearly lags in capital-intensive technologies, such as the LSI fabrication. On that first chart you saw that eight out of those 16 technologies are capital intensive. And unless some changes are made, we do not see an easy way for us to regain leadership in those capital-intensive technologies.

And the fourth element, which I think is an optimistic comment, is that as you look across all 16 of these, there is hope in these areas if we can in fact make more aggressive investments, and if we work in a more productive environment. So there was not any of these 16 that the 11 technologists looked at and said we are hopelessly lost and that there is no way to recover.

So, with those four conclusions, we now, this summer and fall, are going forward to complete this report, and then move forward and understand what public policy items we might advocate which will strengthen the success factors and allow us to maintain or gain leadership in these 16 technologies. And I would say in closing, we simply would look forward to working with our colleagues in the computer systems industry and working with you, Mr. Chairman, and other members of Congress, to help advocate and implement some of the policy changes that will be required to get us into a more favorable position.

Thank you.

[The statement follows:]

STATEMENT OF DR. SAMUEL H. FULLER, ON BEHALF OF THE COMPUTER SYSTEMS POLICY CORP.

MY NAME IS DR. SAM FULLER. I AM VICE PRESIDENT OF CORPORATE RESEARCH AT DIGITAL EQUIPMENT CORPORATION. I WANT TO THANK YOU FOR INVITING ME HERE TO TESTIFY ON BEHALF OF THE COMPUTER SYSTEMS POLICY PROJECT (CSPP).

THE COMPUTER SYSTEMS POLICY PROJECT WAS FORMED LAST FALL BY ELEVEN CEOS FROM THE COMPUTER SYSTEMS INDUSTRY TO DEVELOP AND ADVOCATE A PUBLIC POLICY AGENDA THAT REPRESENTS THE CONSENSUS VIEW OF OUR INDUSTRY.

IN ADDITION TO DIGITAL EQUIPMENT, CSPP'S MEMBERS INCLUDE: APPLE COMPUTER, COMPAQ COMPUTER, CONTROL DATA CORPORATION, CRAY RESEARCH, HEWLETT-PACKARD, IBM, NCR CORPORATION, SUN MICROSYSTEMS, TANDEM COMPUTERS AND UNISYS CORPORATION.

AS YOU KNOW, THE COMPUTER SYSTEMS INDUSTRY PLAYS A VITAL ROLE IN THE U.S. ECONOMY. IN 1989, OUR INDUSTRY:

- SHIPPED $164 BILLION IN HARDWARE, SOFTWARE AND SERVICES;
- EMPLOYED 587,000 WORKERS IN THE U.S.; AND
- EXPORTED $22.4 BILLION IN COMPUTER EQUIPMENT -- 6% OF TOTAL U.S. EXPORTS.

SINCE THE CEOS OF CSPP JOINED TOGETHER, WE HAVE SPENT A SIGNIFICANT AMOUNT OF TIME CAREFULLY AND THOUGHTFULLY ANALYZING THE TECHNOLOGY ISSUES WHICH AFFECT OUR INDUSTRY. I AM HERE TODAY TO SHARE WITH YOU THE RESULTS OF OUR FIRST TECHNOLOGY REPORT, SUCCESS FACTORS IN CRITICAL TECHNOLOGIES, WHICH WAS RELEASED LAST THURSDAY. I HAVE A COMPLETE COPY OF THE REPORT WHICH I WOULD LIKE TO SUBMIT FOR THE RECORD.

IN OUR VIEW, THIS REPORT IS SIGNIFICANT FOR FOUR PRIMARY REASONS:

FIRST -- THIS PROJECT, FOR THE FIRST TIME, BROUGHT TOGETHER THOSE FROM OUR INDUSTRY WHO KNOW THE MOST ABOUT THE TRENDS AND TECHNOLOGIES CRITICAL TO OUR INDUSTRY -- THE CHIEF TECHNOLOGISTS;

SECOND -- WE IDENTIFIED 16 TECHNOLOGIES CRITICAL TO THE INDUSTRY AND REACHED CONSENSUS ABOUT THE STATUS OF THE TECHNOLOGIES VIS A VIS THE REST OF THE WORLD. IN ADDITION, WE FORMED A COLLECTIVE VIEW ABOUT WHERE THOSE TECHNOLOGIES WILL BE IN FIVE YEARS AT CURRENT COURSE AND SPEED AND WHERE THE TECHNOLOGIES COULD BE IF OPTIMAL CHANGES ARE MADE.

THIRD -- WE DEVISED A METHODOLOGY TO ASSESS THE CURRENT COURSE OF DEVELOPMENT OF TECHNOLOGIES AS WELL AS THE POTENTIAL COURSE OF DEVELOPMENT OF TECHNOLOGIES;

FOURTH -- AND MOST IMPORTANT, WE DID NOT LIMIT OURSELVES TO SIMPLY CREATING ANOTHER TECHNOLOGIES LIST. WE TOOK THE PROJECT ONE STEP FURTHER AND IDENTIFIED THE SUCCESS FACTORS THAT WE CONSIDER TO BE CRITICAL IF THE INDUSTRY IS TO EFFECTIVELY COMPETE IN THE 16 TECHNOLOGIES.

WE BEGAN OUR EFFORT SEVERAL MONTHS AGO BY IDENTIFYING THE 16 TECHNOLOGIES WE CONSIDER CRITICAL TO THE HEALTH AND VITALITY OF OUR INDUSTRY AND NATION. THE SIXTEEN TECHNOLOGIES ARE:

1.) DATABASE SYSTEMS;
2.) PROCESSOR ARCHITECTURE;
3.) NETWORKS & COMMUNICATIONS;
4.) HUMAN INTERFACE;
5.) VISUALIZATION;
6.) OPERATING SYSTEMS;
7.) SOFTWARE ENGINEERING;
8.) APPLICATION TECHNOLOGY;
9.) DISPLAYS;
10.) HARDCOPY TECHNOLOGY;
11.) STORAGE;
12.) MANUFACTURING TECHNOLOGY;
13.) INTEGRATED CIRCUIT FABRICATION EQUIPMENT;
14.) MICROELECTRONICS;
15.) OPTOELECTRONICS;
16.) ELECTRONIC PACKAGING.

AFTER PINPOINTING THE CRITICAL TECHNOLOGIES, WE IDENTIFIED 15 SUCCESS FACTORS THAT PROFOUNDLY AFFECT THE ABILITY OF THE U.S. COMPUTER SYSTEMS INDUSTRY TO COMPETE IN THE DEVELOPMENT OF THOSE TECHNOLOGIES WELL INTO THE 21ST CENTURY.

OUR REPORT CONTAINS A LIST WITH DEFINITIONS FOR ALL FIFTEEN SUCCESS FACTORS, BUT GIVEN THE LIMITED TIME THIS MORNING, I WOULD LIKE TO NOTE THE SIX WHICH WE CONSIDER TO BE ESPECIALLY IMPORTANT:

1.) CAPITAL INVESTMENT;
2.) STATE OF THE ART MANUFACTURING;
3.) APPLIED RESEARCH AND DEVELOPMENT;
4.) BASIC RESEARCH;
5.) QUALITY;
6.) EXCEPTIONAL PEOPLE/SKILLED PERSONNEL;

IT IS OUR VIEW THAT THIS LIST OF SUCCESS FACTORS IS THE MOST VALUABLE INFORMATION IN OUR REPORT. IN FACT, WE BELIEVE THAT FORMING A CONSENSUS ON THIS LIST OF FACTORS SETS OUR REPORT APART FROM THE MANY OTHER CRITICAL TECHNOLOGY REPORTS THAT HAVE BEEN ISSUED. **WITH THIS LIST, WE HAVE IDENTIFIED THE LEVERS OR CATALYSTS WHICH, IF IMPROVED, WILL ENHANCE OUR ABILITY TO COMPETE IN THE CRITICAL TECHNOLOGIES.**

TO SEE HOW OUR ANALYSIS WORKS, I WOULD LIKE TO FOCUS FOR A MINUTE ON TWO OF THE TECHNOLOGIES WE IDENTIFIED -- ONE IN WHICH THE U.S. HAS FALLEN BEHIND AND ONE IN WHICH THE U.S. STILL HAS THE LEAD:

1.) ULSI FABRICATION EQUIPMENT AND FACILITIES: IF YOU TURN TO ATTACHMENT #1 OF MY WRITTEN STATEMENT, YOU WILL FIND A FACT SHEET WHICH SUMMARIZES OUR TECHNOLOGISTS ASSESSMENT OF THIS CRITICAL TECHNOLOGY. NINE OF THE FIFTEEN SUCCESS FACTORS WE IDENTIFIED HAVE A HIGH IMPACT ON THIS TECHNOLOGY -- THINGS LIKE CAPITAL INVESTMENT, QUALITY, PRIVATE SECTOR COOPERATION AND PEOPLE/SKILLED PERSONNEL. AN ADDITIONAL 6 SUCCESS FACTORS HAVE A MEDIUM IMPACT ON THE TECHNOLOGY.

   OVERALL, AS YOU CAN SEE FROM THE DIAGRAM, WE FOUND THAT THE U.S. LAGS BEHIND THE REST OF THE WORLD IN THIS TECHNOLOGY. IF, HOWEVER, OPTIMAL IMPROVEMENTS IN THE CRITICAL SUCCESS FACTORS CAN BE MADE, WE FEEL THAT BY 1995 THE U.S. POSITION WOULD IMPROVE QUITE A BIT. IF THESE CHANGES ARE NOT MADE, WE CONCLUDED THAT THE U.S. LEAD WOULD CONTINUE TO ERODE.

2.) PROCESSOR ARCHITECTURE: ATTACHMENT #2 IS A COPY OF THE CHART FOR THIS CRITICAL TECHNOLOGY. AS YOU CAN SEE FROM THE DIAGRAM, OUR ELEVEN TECHNOLOGISTS CONCLUDED THAT THIS IS A TECHNOLOGY IN WHICH THE UNITED STATES STILL LEADS THE REST OF THE WORLD. IF OPTIMAL IMPROVEMENTS ARE MADE IN THREE HIGH-IMPACT CRITICAL SUCCESS FACTORS -- APPLIED RESEARCH AND DEVELOPMENT; BASIC RESEARCH AND PEOPLE/SKILLED PERSONNEL -- AND 6 MEDIUM IMPACT CRITICAL SUCCESS FACTORS, THE U.S. WILL REMAIN AHEAD. IF, HOWEVER, WE CONTINUE AT THE CURRENT COURSE AND SPEED, WE WILL SURELY LOSE OUR LEAD.

WE HOPE THIS REPORT WILL HELP REVITALIZE THE TECHNOLOGY POLICY DEBATE. OUR METHODOLOGY PROVIDES GOVERNMENT AND INDUSTRY WITH AN ALTERNATIVE TO PICKING TECHNOLOGY "WINNERS AND LOSERS" WHILE PROVIDING SOME DIRECTION ABOUT WHERE TO FOCUS ENERGY TO IMPROVE FUNDAMENTAL POLICY PROBLEMS THAT CAN BOLSTER OUR COMPETITIVE POSITION IN THE TECHNOLOGIES.

TO DATE, OUR WORK HAS LED US TO THE FOLLOWING CONCLUSIONS:

1.) WE, THE COMPANIES OF THE COMPUTER SYSTEMS INDUSTRY, MUST OURSELVES MEET MANY OF THE CHALLENGES OUTLINED IN THE REPORT. WE MUST, FOR EXAMPLE, TAKE RESPONSIBILITY FOR IMPROVING THINGS LIKE QUALITY, AND MANUFACTURING.

2.) THE UNITED STATES MAINTAINS A COMPETITIVE LEAD IN THE TECHNOLOGIES THAT STRESS CREATIVITY AND HUMAN FACTORS AND ARE LESS CAPITAL INTENSIVE. FOR EXAMPLE, SOFTWARE ENGINEERING, APPLICATIONS TECHNOLOGIES AND COMPUTER PROCESSOR ARCHITECTURE TECHNOLOGIES;

3.) THE U.S. LAGS IN CAPITAL INTENSIVE TECHNOLOGIES LIKE ULTRA LARGE SCALE INTEGRATION FABRICATION EQUIPMENT AND FACILITIES, MICROELECTRONICS AND MANUFACTURING. THE U.S. ALSO LAGS IN PRODUCT-RELATED TECHNOLOGIES LIKE OPTICAL STORAGE, DISPLAYS AND HARDCOPY TECHNOLOGY;

4.) U.S. INDUSTRY HAS THE ABILITY TO IMPROVE ITS CURRENT PERFORMANCE IN ALL THE KEY TECHNOLOGIES.

BY THE END OF 1990, WE EXPECT TO COMPLETE THE NEXT PHASE OF OUR PROJECT. BASED ON THE CRITICAL SUCCESS FACTORS AND TECHNOLOGIES WE HAVE IDENTIFIED, WE WILL ANALYZE THE PUBLIC POLICIES THAT HAVE A MAJOR IMPACT ON OUR INDUSTRY. WHEN WE COMPLETE THE ANALYSIS, WE WILL PRESENT A SET OF SPECIFIC TECHNOLOGY POLICY RECOMMENDATIONS FOR INDUSTRY AND GOVERNMENT.

WE LOOK FORWARD TO WORKING AMONGST OURSELVES, WITH OUR COLLEAGUES IN INDUSTRY AND WITH YOU IN THE CONGRESS TO MAKE THE POLICY CHANGES AND IMPROVEMENTS THAT WILL CREATE THE BEST POSSIBLE ENVIRONMENT FOR CONTINUED U.S. TECHNOLOGICAL SUCCESS. THANK YOU.

ATTACHMENT #1

USLI FABRICATION EQUIPMENT AND FACILITIES

DEFINITION: Integrated circuit fabrication equipment and production facilities with increasingly refined clean room environments, materials, equipment and lithography technology.

HIGH-IMPACT CRITICAL SUCCESS FACTORS:

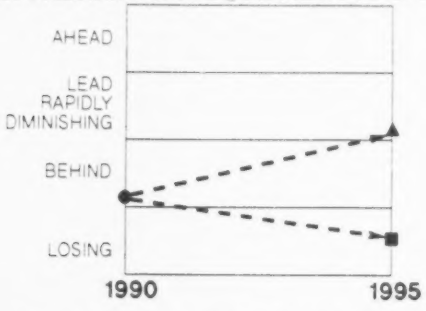
- Capital Investment
- Critical Mass
- State of Art Manufacturing
- Quality
- Applied Research and Development
- Private Sector Cooperation
- Basic Research
- Research, Development and Manufacturing Linkages
- People: Skilled Personnel

MEDIUM-IMPACT CRITICAL SUCCESS FACTORS:

- Large Market Size
- Collaboration with Academia, Government and Business
- Standardization and Standards
- Intellectual Property Protection
- Culture Issues
- Reduced Risk for Large Emerging Market

POSITION OF U.S. COMPUTER SYSTEMS INDUSTRY VS. WORLD:

ULSI FABRICATION EQUIPMENT AND FACILITIES



● 1990 - CURRENT STATUS VS. REST OF WORLD (ROW)
■ 1995 - CURRENT COURSE AND SPEED VS. ROW
▲ 1995 - OPTIMAL ACHIEVABLE

ATTACHMENT #2

PROCESSOR ARCHITECTURE

DEFINITION: The instruction set portion of the computer processor describes the bit-level definition of the data and the instructions the machine can process. The instruction set defines the machine-executable portions of the interface to which software is assembled, compiled and linked. Instruction sets can be organized into different types of architectures such as Complex Instruction Computer Systems (CISC), Reduced Instruction Set Computing (RISC), superscalar, wide-word, multi-processor and massively parallel.

HIGH-IMPACT CRITICAL SUCCESS FACTORS:

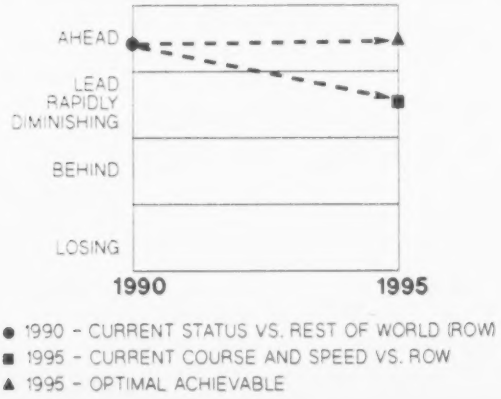
- Applied Research and Development
- Basic Research
- People: Skilled Personnel

MEDIUM-IMPACT CRITICAL SUCCESS FACTORS:

- Capital Investment
- Critical Mass
- Large Market Size
- Quality
- Collaboration with Academia, Government and Business
- Intellectual Property Protection

POSITION OF U.S. COMPUTER INDUSTRY VS. WORLD:

PROCESSOR ARCHITECTURE



Senator GORE. I thank you, not only for your statement, but for the impressive work that you and your colleagues have done in producing this report. I am most impressed with it. And it will be referred to frequently in the months ahead as we analyze these issues, and hopefully organize a response.

So I do appreciate it very much, and I speak for many others in saying that.

Again, we will hold questions until the panel has completed its testimony. And our next witness is Mr. Peter Mills, Senior Vice President for Administration with SEMATECH. We are still thinking of Bob Noyce and your corporate family, Mr. Mills, as well as his family. And our whole country suffered a great loss with his untimely death, and we wish all of you well as you continue your very

valuable and important activities at SEMATECH, and we look forward to hearing from you this morning.

STATEMENT OF PETER MILLS, SENIOR VICE PRESIDENT FOR ADMINISTRATION, SEMATECH

Mr. MILLS. I appreciate those thoughts, Mr. Chairman. We are more dedicated than ever now to fulfill our mission.

Mr. Chairman, I appreciate the opportunity to address your Subcommittee on U.S. competitiveness in electronics this morning.

In addition to SEMATECH's mission to help restore U.S. competitiveness by focusing on semiconductor manufacturing technology, SEMATECH also has the objective to strengthen the semiconductor equipment and materials industry which supply the tools for semiconductor manufacturing. To do this, we have brought together U.S. industry, the Department of Defense, and the National Laboratories, as well as academia.

I would like to address three basic questions posed by your staff, Mr. Chairman.

First, to explain what happened between SEMATECH and Semi-Gas Systems once we were informed that Semi-Gas was about to be sold to a foreign firm. Second, the impact such a sale would have on SEMATECH. And third, our suggestions on the steps we feel appropriate for our government to take in such situations.

I think it is important to note that pure specialty gases are an essential ingredient in the manufacturing of all integrated circuits. SEMATECH's mission of restoring semiconductor manufacturing capability to the U.S. is dependent on developing many critical technologies, including world-class gas purity systems. As semiconductor circuity continues to shrink, ultra-pure gases are essential for semiconductor manufacturing.

Through a joint development project with SEMATECH, Semi-Gas has been able to improve its purity levels by tenfold, giving it a world leadership position. This is a real success story for SEMATECH and for U.S. industry. This technology development has been the result of major resources, effort, and expertise from SEMATECH in a teaming arrangement initiated by SEMATECH with two other U.S. gas suppliers.

If Semi-Gas is sold to Nippon Sanso, America will use a valuable and competitive supplier of a critical technology. With great difficulty, SEMATECH can replace Semi-Gas in our facility, but how are we going to replace the Semi-Gas presence in our industry with a competitive American firm?

The Japanese understand the importance of Semi-Gas. In fact, the purchase of Semi-Gas is an excellent way to gain unique insights into the advances we are making at SEMATECH in semiconductor manufacturing. But SEMATECH also understood the importance of Semi-Gas, and together with Semi/SEMATECH, we immediately alerted officials at the Committee on Foreign Investment in the U.S., or CFIUS. Our message was clear and concise, the sale of Semi-Gas to Nippon Sanso of Japan would pose a serious threat to SEMATECH's national mission, and should not be allowed at this time on two grounds, national security and antitrust.

First, there is a major national security stake in maintaining U.S. leadership in this technology. It is as critical to support manufacturing for defense electronics as it is for computers and telecommunications. We estimate that the technology of Semi-Gas is now at least two years ahead of the Nippon Sanso technology, and probably any other technology in the world today.

You cannot have the best defense capability in the world if you cannot produce the best computer chips in the world. And you cannot produce the best computer chips in the world if you do not have the best semiconductor manufacturing technology in the world. That, in a nutshell, is why the U.S. Government joined in the unique partnership with the U.S. semiconductor industry known as SEMATECH.

The second ground for our concern was antitrust. If Nippon Sanso were an American firm, we do not believe it could purchase Semi-Gas under U.S. antitrust laws. The combined market share of Nippon Sanso and Semi-Gas would simply be too large and powerful. Yet, as a foreign firm, Nippon Sanso may be able to purchase Semi-Gas.

I respectfully urge the Subcommittee to consider that statement. We may sell a technology jewel like Semi-Gas to a foreign firm, but we may not allow a similar U.S. firm to purchase it.

We carried these two messages to the Government through the CFIUS process in April and May. We were disappointed, but not surprised, that CFIUS recommended that the sale be approved. We still hope that the Department of Justice will block this sale on antitrust grounds. If the sale does become final, we will pursue every legal avenue to try to assure that SEMATECH confidential information is protected from Nippon Sanso. And we will do whatever it takes to maintain our momentum without a valuable supplier like Semi-Gas.

You can also rest assured that should the sale be finalized, Nippon Sanso and Semi-Gas will not have access to the world-class facility we have built in Austin, Texas. Our mission is to advance the capabilities of the U.S. semiconductor industry.

The third question posed by your Subcommittee, Mr. Chairman, involved our views on what Government should consider in the future to keep critical technology leaders like Semi-Gas out of the hands of foreign competitors. There are two specific areas I would urge the Subcommittee to consider.

First, the CFIUS process; and second, the impact of foreign acquisition on the semiconductor industry, and on America.

The CFIUS process has many shortcomings. One, national security is not well defined in this process. Two, the CFIUS process does not involve a mechanism for advance warning or notice of foreign acquisition of U.S. firms. Three, the CFIUS process is also shrouded in unnecessary secrecy.

This past Monday, the "Wall Street Journal" outlined in great detail a proposal put forth by this administration to protect SEMATECH's interests and property from Nippon Sanso, given that the sale was approved. I read that with more than a little interest, inasmuch as that was the first I had ever heard of it.

Senator GORE. Now wait a minute. You found out about this from a press release?

Mr. MILLS. I read about it in the "Wall Street Journal" for the first time, which greatly detailed an outline of a scheme to protect SEMATECH and its interests. The first I had heard about on this was this past Monday when I read about it in the "Wall Street Journal."

Senator GORE. Well, let me get this straight. Your concern about the purchase was partly based on the fact that this would give to the Japanese competition key technologies financed by U.S. taxpayers as part of our strategy to develop a competitive response. When the administration, over your objections, approved the sale, they put out a press release saying that they had developed this plan to protect your technologies, but they did not consult with you on that plan? You found out about it by reading the newspaper?

Mr. MILLS. That is correct.

Senator GORE. Well, how can the plan possibly be well attuned to protecting your technologies if they did not even consult with the people who know about the technologies?

Mr. MILLS. A very good point, Mr. Chairman.

And I would submit that those of us responsible for the management of the operation of SEMATECH must be an integral part of that process in developing any plan designed to protect our interests and property.

Senator GORE. Well, maybe it is just P.R. Maybe the administration is just trying to pull the wool over our eyes and pretend that it is protecting these technologies. If it is not even consulting with the people who know how to protect them, who advised them not to sell this company to the Japanese, then they are just faking it. They are pretending to protect it. They are pretending to protect our national security interests here. But, instead, they are just surrendering to the Japanese, because they are scared to challenge them.

I may want to put into the record at the appropriate time the list of critical technologies owned in full or in part by SEMATECH with Semi-Gas systems. It is an incredible list of jewels that we are, thanks to President Bush, turning over to the Japanese.

I will ask some questions later about these, but I really think this is an outrageous decision. It is an example of a trend, but it is a kind of electronic Teapot Dome. They are just giving away taxpayer-financed assets to the very people, to the very companies in Japan against which these technologies were developed to compete. It is just absolutely incredible.

Anyway, go ahead.

Mr. MILLS. Thank you. That one had our attention as well.

Number four, CFIUS has no procedure to follow up on transactions in order to assure that foreign entities have complied with proposed requirements for such transaction. Again, I believe t is absolutely essential that those people responsible for the management of the operation be involved in the process of developing any plan.

Number five, CFIUS should be required to consider the cumulative effect of multiple transactions. CFIUS has suggested that the sale of Nippon Sanso would not adversely affect our national security, but at some point the cumulative effect of these sales must be considered.

If all the foreign acquisitions of the past two years had been presented to the government in one fell swoop, that would have been greeted with outrage. Mr. Chairman, our foreign competitors are picking off our technology jewels one by one, and that is no less an outrage.

Senator GORE. Now did the employees of this company organize a counter-offer that was $20 million instead of $25 million?

Mr. MILLS. It was not a counter-offer. They put together a proposal for a management-led buyout of the firm, and it came up, about $5 million shy.

Senator GORE. About $5 million shy, but it is going to cost SEMATECH, including the U.S. taxpayers, $100 million to try to replace this company.

Mr. MILLS. In the worst case scenario. Obviously we are going to look at all alternatives and pursue the cheapest means available.

Senator GORE. In the meantime, the key technologies that are in this case 2 years ahead of anything the Japanese have will be available to them to exploit the fruits of the U.S. taxpayer-financed effort to compete with them.

You know, we have had concerns about U.S. basic research being turned over to foreign competition. Now we have, courtesy of the Bush administration, active U.S. taxpayer subsidies to the Japanese effort to take over the few remaining areas in which we have a lead in this field.

I am sorry to interrupt again. I am just incredulous that President Bush would allow this. It is absolutely incredible. Anyway, I am sorry. Go ahead. Complete your statement, and we will finish out this panel.

Mr. MILLS. You are always welcome to interrupt, Mr. Chairman.

Bottom line, if we are to be competitive in an industry as critical to our national defense and our national economy as semiconductors, we must take action. We can start by adjusting the CFIUS process to address some of the areas that I have mentioned.

The CFIUS process is not achieving its legislative intent. Since its inception, more than 400 transactions have been referred to CPS, only 10 of those have been formally investigated, and of those only 1 sale was blocked. The process is broken, and it needs fixing. SEMATECH stands ready to work with the government in developing solutions.

Thank you.

[The statement follows:]

STATEMENT OF PETER H. MILLS, CHIEF ADMINISTRATIVE OFFICER, SEMATECH

MR. CHAIRMAN, I AM GLAD TO HAVE THE OPPORTUNITY TO ADDRESS YOUR SUBCOMMITTEE ON U.S. COMPETITIVENESS IN ELECTRONICS THIS MORNING.

AS YOU KNOW, SEMATECH'S MISSION IS TO HELP TO RESTORE U.S. COMPETITIVENESS BY FOCUSING ON SEMICONDUCTOR MANUFACTURING TECHNOLOGY. BY BRINGING TOGETHER U.S. INDUSTRY, THE DEPARTMENT OF DEFENSE (AND THE NATIONAL LABORATORIES), AS WELL AS ACADEMIA, SEMATECH HAS SOUGHT TO DEVELOP GENERIC MANUFACTURING TECHNOLOGY THAT CAN BE USED BY U.S INDUSTRY TO DEVELOP WORLD LEADERSHIP.

SEMATECH'S OBJECTIVE HAS ALSO BEEN TO STRENGTHEN THE SEMICONDUCTOR EQUIPMENT AND MATERIALS INDUSTRY WHICH SUPPLY THE TOOLS FOR SEMICONDUCTOR MANUFACTURING.

MR. CHAIRMAN, I WOULD LIKE TO BEGIN BY ADDRESSING THREE BASIC QUESTIONS POSED BY YOUR STAFF: FIRST, TO EXPLAIN WHAT HAPPENED BETWEEN SEMATECH AND SEMI-GAS SYSTEMS ONCE WE WERE INFORMED THAT SEMI-GAS WAS ABOUT TO BE SOLD TO A FOREIGN FIRM; SECOND, THE IMPACT SUCH A SALE WOULD HAVE ON SEMATECH; AND, THIRD, OUR SUGGESTIONS TO THIS SUBCOMMITTEE ON THE STEPS WE FEEL APPROPRIATE FOR OUR GOVERNMENT TO TAKE IN SUCH SITUATIONS.

I THINK IT IS IMPORTANT TO NOTE THAT PURE SPECIALTY GASES ARE AN ESSENTIAL INGREDIENT IN THE MANUFACTURING OF ALL INTEGRATED CIRCUITS. SEMATECH'S MISSION OF RESTORING SEMICONDUCTOR MANUFACTURING CAPABILITY TO THE U.S. IS DEPENDENT ON DEVELOPING MANY CRITICAL TECHNOLOGIES, INCLUDING WORLD-CLASS GAS PURITY SYSTEMS. AS SEMICONDUCTOR CIRCUITRY CONTINUES TO SHRINK, ULTRA PURE GASES ARE ESSENTIAL FOR SEMICONDUCTOR MANUFACTURING. THROUGH A JOINT DEVELOPMENT PROJECT WITH SEMATECH, SEMI-GAS HAS BEEN ABLE TO IMPROVE ITS PURITY LEVELS BY TENFOLD GIVING IT A WORLD LEADERSHIP POSITION. THIS IS A REAL SUCCESS STORY FOR SEMATECH AND FOR U.S. INDUSTRY.

THIS TECHNOLOGY DEVELOPMENT HAS BEEN THE RESULT OF MAJOR RESOURCES, EFFORT AND EXPERTISE FROM SEMATECH IN A TEAMING ARRANGEMENT INITIATED BY SEMATECH WITH TWO OTHER U.S. GAS SUPPLIERS. IF SEMI-GAS IS SOLD TO NIPPON SANSO, AMERICA WILL LOSE A VALUABLE AND COMPETITIVE SUPPLIER OF A CRITICAL TECHNOLOGY. WITH DIFFICULTY, SEMATECH CAN REPLACE SEMI-GAS IN OUR FACILITY, BUT HOW ARE WE GOING TO REPLACE THE SEMI-GAS PRESENCE IN OUR INDUSTRY WITH A COMPETITIVE AMERICAN FIRM?

THE JAPANESE UNDERSTAND THE IMPORTANCE OF SEMI-GAS. IN FACT, THE PURCHASE OF SEMI-GAS IS AN EXCELLENT WAY TO GAIN UNIQUE INSIGHTS INTO THE ADVANCES WE ARE MAKING AT SEMATECH IN SEMICONDUCTOR MANUFACTURING.

SEMATECH BECAME AWARE OF THE PENDING SALE OF SEMI-GAS SYSTEMS IN JANUARY OF 1990. IN A LETTER TO THE PARENT COMPANY OF SEMI-GAS SYSTEMS, DR. SAM HARRELL, THE PRESIDENT OF SEMI/SEMATECH, URGED THE COMPANY TO SELL TO A U.S. FIRM. WE WERE INITIALLY ENCOURAGED BY THE PROSPECTS OF A LEVERAGED BUY OUT ON THE PART OF THE SEMI-GAS MANAGEMENT TEAM.

THOSE HOPES WERE DASHED WHEN WE WERE INFORMED BY SEMI-GAS THAT NIPPON SANSO OF JAPAN HAD COME TO TERMS WITH THE PARENT COMPANY OF SEMI-GAS, HERCULES INCORPORATED ON APRIL THE 13TH. IRONICALLY, MR. CHAIRMAN, THAT WAS FRIDAY THE 13TH. ON APRIL THE 18TH, SEMATECH INFORMED MR. DAVID HOLLINGSWORTH, THE CHAIRMAN OF THE HERCULES BOARD OF DIRECTORS, THAT WE FULLY EXPECTED HERCULES AND SEMI-GAS TO HONOR ITS COMMITMENTS TO PROTECT SEMATECH INTELLECTUAL PROPERTY. WE ATTACHED TO THAT LETTER A TWO-PAGE LISTING OF TECHNOLOGIES OWNED IN FULL OR IN PART BY SEMATECH WITH SEMI-GAS SYSTEMS.

SEMI/SEMATECH AND SEMATECH ALERTED OFFICIALS AT THE COMMITTEE ON FOREIGN INVESTMENT IN THE U.S., OR CFIUS, AS WELL AS THE DEPARTMENT OF COMMERCE, THE DEPARTMENT OF DEFENSE, AND THE JUSTICE DEPARTMENT.

OUR MESSAGE WAS CLEAR AND CONCISE: THE SALE OF SEMI-GAS TO NIPPON SANSO OF JAPAN WOULD POSE A SERIOUS THREAT TO SEMATECH'S NATIONAL MISSION AND SHOULD NOT BE ALLOWED AT THIS TIME ON TWO GROUNDS:

FIRST, THERE IS A MAJOR NATIONAL SECURITY STAKE IN MAINTAINING U.S. LEADERSHIP IN THIS TECHNOLOGY. IT IS AS CRITICAL TO SUPPORT MANUFACTURING FOR DEFENSE ELECTRONICS AS IT IS FOR COMPUTERS AND TELECOMMUNICATION. WE ESTIMATE THAT THE TECHNOLOGY OF SEMI-GAS IS NOW AT LEAST TWO YEARS AHEAD OF THE NIPPON SANSO TECHNOLOGY AND PROBABLY ANY OTHER TECHNOLOGY IN THE WORLD TODAY.

YOU CANNOT HAVE THE BEST DEFENSE CAPABILITY IN THE WORLD IF YOU CANNOT PRODUCE THE BEST COMPUTER CHIPS IN THE WORLD AND YOU CANNOT PRODUCE THE BEST COMPUTER CHIPS IF YOU DO NOT HAVE THE BEST SEMICONDUCTOR MANUFACTURING TECHNOLOGY IN THE WORLD.

THAT, IN A NUTSHELL, IS WHY THE U.S. GOVERNMENT JOINED IN THE UNIQUE PARTNERSHIP WITH THE U.S. SEMICONDUCTOR INDUSTRY NOW KNOWN AS SEMATECH.

THE SECOND GROUND FOR CONCERN WAS ANTITRUST. IF NIPPON SANSO WERE AN AMERICAN FIRM, WE DO NOT BELIEVE IT COULD PURCHASE SEMI-GAS UNDER OUR ANTITRUST LAWS. THE COMBINED MARKET SHARE OF NIPPON SANSO AND SEMI-GAS WOULD SIMPLY BE TOO LARGE AND POWERFUL. YET, AS A FOREIGN FIRM, NIPPON SANSO MAY BE ABLE TO PURCHASE SEMI-GAS.

I RESPECTFULLY URGE THE SUBCOMMITTEE TO CONSIDER THAT STATEMENT. WE MAY SELL A TECHNOLOGY JEWEL LIKE SEMI-GAS TO A FOREIGN FIRM, BUT WE MAY NOT ALLOW A SIMILAR U.S. FIRM TO PURCHASE IT.

WE DID OUR BEST TO CARRY THESE TWO MESSAGES TO THE GOVERNMENT THROUGH THE CFIUS PROCESS IN APRIL AND MAY. WE WERE DISAPPOINTED, BUT NOT SURPRISED, THAT CFIUS RECOMMENDED THAT THE SALE BE APPROVED.

WE STILL HOPE THAT THE DEPARTMENT OF JUSTICE WILL BLOCK THE SALE ON ANTITRUST GROUNDS. IF THE SALE DOES BECOME FINAL, WE WILL TAKE ADVANTAGE OF EVERY LEGAL AVENUE TO TRY TO ASSURE THAT SEMATECH CONFIDENTIAL INFORMATION IS PROTECTED FROM NIPPON SANSO, AND WE WILL DO WHATEVER IT TAKES TO MAINTAIN OUR MOMENTUM WITHOUT A VALUABLE SUPPLIER LIKE SEMI-GAS.

YOU CAN REST ASSURED THAT SHOULD THE SALE BE FINALIZED, NIPPON SANSO AND SEMI-GAS WILL NOT HAVE ACCESS TO THE WORLD-CLASS FACILITY WE HAVE BUILT IN AUSTIN, TEXAS. OUR MISSION IS TO ADVANCE THE CAPABILITIES OF THE U.S. SEMICONDUCTOR INDUSTRY.

THE THIRD QUESTION POSED BY YOUR SUBCOMMITTEE, MR. CHAIRMAN, INVOLVED OUR VIEWS ON WHAT GOVERNMENT SHOULD CONSIDER IN THE FUTURE TO KEEP CRITICAL TECHNOLOGY LEADERS LIKE SEMI-GAS OUT OF THE HANDS OF FOREIGN COMPETITORS.

THERE ARE TWO SPECIFIC AREAS I WOULD URGE THE SUBCOMMITTEE TO CONSIDER: FIRST, THE CFIUS PROCESS AND SECOND, THE IMPACT OF FOREIGN ACQUISITION ON THE SEMICONDUCTOR INDUSTRY AND ON AMERICA.

THE CFIUS PROCESS HAS MANY SHORTCOMINGS. NATIONAL SECURITY IS NOT WELL-DEFINED. PRESENTLY, THE DEFINITION OF NATIONAL SECURITY IS TOO NARROWLY APPLIED IN A STRICT MILITARY SENSE. THE DEFINITION MUST BE BROADENED TO INCLUDE CRITICAL TECHNOLOGIES THAT WILL DETERMINE OUR WORLD LEADERSHIP POSITION IN THE FUTURE.

IN ADDITION, THE CFIUS PROCESS DOES NOT INVOLVE A MECHANISM FOR ADVANCED WARNING OR NOTICE OF FOREIGN ACQUISITION OF U.S. FIRMS. THE ENTIRE CFIUS PROCESS IS TRIGGERED AFTER THE FACT AND ONLY IF INDUSTRY SOMEHOW LEARNS ABOUT A TRANSACTION. IN THE CASE OF SEMI-GAS, A LETTER TO DR. SAM HARRELL FROM THE PRESIDENT OF SEMI-GAS WAS THE FIRST NOTICE. HAD WE NOT RECEIVED THAT NOTICE AND EMPHASIZED THE UNIQUE POSITION OF SEMI-GAS, WE DO NOT BELIEVE THAT CFIUS WOULD HAVE INVESTIGATED THE PROPOSED SALE.

THE CFIUS PROCESS IS ALSO SHROUDED IN UNNECESSARY SECRECY. WE WERE ASKED TO RESPOND AND TESTIFY ON A CONFIDENTIAL BASIS, WHICH WE DID. YET IN THE JULY 30TH EDITION OF THE WALL STREET JOURNAL WE READ, "AN ADMINISTRATION OFFICIAL SAID NIPPON SANSO WILL BE REQUIRED TO ISOLATE ITSELF FROM THE WORK BEING PERFORMED BY FIVE SEMI-GAS TECHNICIANS AT SEMATECH .... THESE TECHNICIANS WILL REPORT TO A SEPARATE CORPORATION GOVERNED BY A BOARD MADE UP OF U.S. CITIZENS, INCLUDING ONE TO BE NOMINATED BY SEMATECH. A VOTING TRUST WILL BE SET UP TO SEPARATE NIPPON SANSO FROM THE SEMATECH OPERATION AND SEMI-GAS WILL BE REQUIRED TO PROVIDE A SECURE AREA FOR THE PROTECTION OF SEMATECH DOCUMENTS, THE U.S. OFFICIAL SAID.

THE PLAN ALSO CALLS FOR SANCTIONS AGAINST THE JAPANESE ACQUIRER IF IT VIOLATES THESE SECURITY PRECAUTIONS."

I READ THAT ARTICLE WITH MORE THAN A LITTLE INTEREST SINCE SEMATECH HAD NO PART WHATSOEVER IN DEVELOPING SUCH AN ELABORATE SUGGESTION TO PROTECT OUR INTELLECTUAL PROPERTY. I SUBMIT THAT THOSE OF US RESPONSIBLE FOR MANAGING THE OPERATION OF SEMATECH MUST BE AN INTEGRAL PART OF THE PROCESS IN DEVELOPING ANY PLAN DESIGNED TO PROTECT OUR PROPERTY.

ANOTHER PROBLEM IS THAT CFIUS HAS NO PROCEDURE FOR FOLLOWING UP TO ASSURE THAT FOREIGN ENTITIES HAVE COMPLIED WITH PROPOSED REQUIREMENTS FOR A TRANSACTION. FOR EXAMPLE, IT WOULD BE EASY FOR NIPPON SANSO TO AGREE TO REQUIREMENTS WHEN THEY KNOW THERE IS NO MECHANISM TO MONITOR COMPLIANCE.

FINALLY, MR. CHAIRMAN, CFIUS SHOULD BE REQUIRED TO CONSIDER THE CUMULATIVE EFFECT OF MULTIPLE TRANSACTIONS. CFIUS HAS SUGGESTED THAT THE SALE OF NIPPON SANSO WOULD NOT ADVERSELY AFFECT OUR NATIONAL SECURITY. BUT AT SOME POINT, THE CUMULATIVE EFFECT OF THESE SALES MUST BE CONSIDERED. IF ALL THE FOREIGN ACQUISITIONS OF THE PAST TWO YEARS HAD BEEN PRESENTED TO THE GOVERNMENT IN ONE FELL SWOOP, THAT WOULD BE GREETED WITH OUTRAGE.

MR. CHAIRMAN, OUR FOREIGN COMPETITORS ARE PICKING OFF OUR TECHNOLOGY JEWELS ONE BY ONE. AND IT IS NO LESS AN OUTRAGE. IF WE ARE TO BE COMPETITIVE IN AN INDUSTRY AS CRITICAL TO OUR NATIONAL DEFENSE AND OUR NATIONAL ECONOMY AS SEMICONDUCTORS, WE MUST TAKE ACTION.

WE CAN START BY ADJUSTING THE CFIUS PROCESS TO ADDRESS SOME OF THE AREAS I HAVE MENTIONED.

THE CFIUS PROCESS IS NOT ACHIEVING ITS LEGISLATIVE INTENT. SINCE ITS INCEPTION, MORE THAN 400 TRANSACTIONS HAVE BEEN REFERRED TO CFIUS. ONLY 10 HAVE BEEN FORMALLY INVESTIGATED, AND OF THOSE, ONLY ONE SALE WAS BLOCKED. THE PROCESS IS BROKEN AND IT NEEDS FIXING.

I WOULD ALSO URGE THE SUBCOMMITTEE TO CONTINUE DELVING INTO THE TWO PRIMARY AREAS THAT BRING US HERE THIS MORNING: GENERALLY, THE IMPACT OF FOREIGN INVESTMENT IN THE UNITED STATES, AND SPECIFICALLY, THE IMPACT OF FOREIGN ACQUISITION ON THE SEMICONDUCTOR INDUSTRY. YET I THINK WE SHOULD NOT ONLY LOOK AT WHAT IS HAPPENING IN THOSE AREAS, BUT ALSO WHY. I URGE YOU TO LOOK AT BOTH THE EFFECT AND THE CAUSE.

THE EFFECTS OF FOREIGN INVESTMENT ON THE SEMICONDUCTOR INDUSTRY HAVE BEEN DOCUMENTED THIS MORNING. TWO MAJOR CAUSES INCLUDE OUR TRADE DEFICIT AND OUR LACK OF NATIONAL WILL POWER WHEN IT COMES TO SAVING.

FOREIGN FIRMS ARE ABLE TO PURCHASE OUR COMPANIES AND OUR TECHNOLOGIES BECAUSE THEY HAVE THE AMERICAN DOLLARS TO DO SO, AMERICAN DOLLARS GAINED BY SELLING MORE OF THEIR PRODUCTS TO US THAN THEY BUY IN AMERICAN MANUFACTURED GOODS. CLEARLY, JAPAN HAS SHOWN A TENDENCY TO TRADE THEIR MANUFACTURED GOODS IN EXCHANGE FOR AMERICAN ASSETS. WE GIVE THEM AMERICAN DOLLARS FOR TOYOTAS AND SONYS. THEY GIVE THEM BACK TO US IN EXCHANGE FOR LAND AND COMPANIES. THE DOLLARS-FOR-ASSETS EXCHANGE IS A SOUND STRATEGY FOR JAPAN. IT ALLOWS THEM TO KEEP THEIR COMPETITORS AT A FURTHER AND FURTHER DISADVANTAGE, ESPECIALLY WHEN THAT COMPETITOR HAS LIMITED MEANS BY WHICH TO RAISE DOLLARS AND COMPETE WITH THEM FOR VALUABLE ASSETS ON THE SELLING BLOCK. AMERICA HAS LIMITED CAPITAL THESE DAYS BECAUSE AS INDIVIDUALS, AS PRIVATE FIRMS, AND AS A GOVERNMENT WE DO NOT SAVE. WE ARE A NATION OF VORACIOUS CONSUMERS AND ANEMIC SAVERS. WE NEED TO BRING MORE BALANCE TO THAT EQUATION.

THE SEMICONDUCTOR MANUFACTURING TECHNOLOGY CONSORTIUM -- OR SEMATECH -- WAS FORMED IN RESPONSE TO THE ALARMING DECLINE OF AMERICA'S ABILITY TO COMPETE AGAINST BETTER FINANCED, BETTER ORGANIZED, AND, IN MY OPINION, COMPANIES BENEFITTING FROM A NATIONAL WILLPOWER GREATER THAN OUR OWN.

I HOPE THIS MORNING TO CALL ATTENTION TO THE PROBLEMS WHEN WE AS A NATION ALLOW HIGH VALUE-ADD JOBS TO LEAVE OUR SHORES; WHEN WE ALLOW OUR EDUCATION SYSTEM TO BECOME ANYTHING BUT FIRST-RATE; WHEN WE CLOSE OUR NATIONAL EYES TO THE REALITIES OF COMPETING ON A GLOBAL SCALE; WHEN WE LOSE CONTROL OF OUR OWN NATIONAL DESTINY BY LOSING OUR LEAD IN TECHNOLOGIES CRITICAL TO BOTH OUR NATIONAL DEFENSE AND OUR NATIONAL STANDARD OF LIVING.

WE ARE ALL AWARE OF THE FACTS. CONGRESS AND THE ADMINISTRATION HAS BEEN PRESENTED WITH REPORTS BY BLUE-RIBBON PANELS SUCH AS THE DEFENSE SCIENCE BOARD REPORT IN 1987 AND, MOST RECENTLY, THE TWO NATIONAL ADVISORY COMMITTEE ON SEMICONDUCTORS REPORTS PUBLISHED WITHIN THE LAST YEAR AS WELL AS THE CONGRESSIONAL BUDGET OFFICE REPORT ON CONSORTIA RELEASED LAST MONTH. THE DEFENSE SCIENCE BOARD REPORT RECOMMENDED THE FORMATION OF A JOINT INDUSTRY-GOVERNMENT-ACADEMIA EFFORT IN SEMICONDUCTOR MANUFACTURING THAT HAS BECOME SEMATECH. I APPLAUD BOTH CONGRESS AND THE ADMINISTRATION FOR CREATING THE ENVIRONMENT THAT ALLOWS A SEMATECH IN THIS COUNTRY. I CAN REPORT WITH PRIDE TODAY THAT SEMATECH IS ALIVE AND WELL AND WORKING.

HOWEVER, WE ALL KNOW THAT A SEMATECH ALONE IS NOT ENOUGH.

WE MUST DIRECT OUR NATIONAL VISION, OUR NATIONAL WILL, AND OUR NATIONAL RESOURCES TOWARD CREATING AN ENVIRONMENT THAT ALLOWS THE AMERICAN ENTREPRENEUR ... AMERICAN FREE ENTERPRISE TO FLOURISH. WE DO NOT HAVE SUCH AN ENVIRONMENT TODAY.

WE AS A NATION ARE DISADVANTAGED BECAUSE OF OUR LOW NATIONAL SAVINGS RATE WHICH CAUSES CAPITAL TO BE SCARCE AND THUS EXPENSIVE.

WE AS A NATION HAVE CLOSED OUR EYES TO THE REALITIES OF WORLD MARKETS. OUR LAWS ARE DESIGNED TO PROTECT AMERICAN COMPANIES COMPETING IN AMERICAN MARKETS, WHEN IN FACT, WE ARE DEALING IN WORLD MARKETS. FOREIGN COMPANIES ARE NOT SIMILARLY RESTRAINED. THE SEMI-GAS EXAMPLE HAS MORE IMPLICATIONS THAN JUST THE SEMICONDUCTOR INDUSTRY. IT SPEAKS TO THE LOSS OF AMERICAN HIGH VALUE-ADD JOBS. WE CANNOT BLAME JAPAN FOR WHAT IS HAPPENING TO OUR INDUSTRIAL BASE. WE CANNOT BLAME JAPAN FOR WANTING HIGH VALUE-ADD JOBS FOR THEIR PEOPLE.

BUT WE MUST TAKE IT UPON OURSELVES TO DEVELOP THE NATIONAL VISION TO REALIZE THE IMPORTANCE OF HIGH VALUE-ADD JOBS TO THE AMERICAN ECONOMY. THE AMERICAN PEOPLE AND OUR GOVERNMENT SHOULD CARE IF AMERICA WINS SUCH HIGH VALUE-ADD JOBS.

IF WE DON'T, WE WILL END UP WITH LOW VALUE-ADD JOBS AND BECOME ONLY A SOURCE FOR RESOURCES AND CHEAP LABOR FOR NATIONS SUCH AS JAPAN THAT WILL BE IN CONTROL OF OUR NATIONAL DESTINY.

IF I CONTROL THE TECHNOLOGY AND THE MARKET, I CONTROL THE KIND OF JOBS I'M WILLING TO LET YOU HAVE; THE WAGES I'M WILLING TO PAY; AND, ULTIMATELY, THE STANDARD OF LIVING I'M WILLING TO ALLOW YOU TO ENJOY.

I BELIEVE THE AMERICAN PEOPLE REALIZE THAT THE GREATEST THREAT TO AMERICA TODAY IS MORE ECONOMIC THAN MILITARY. AND WE HAVE MADE A STEP TOWARD RESPONDING TO THAT ECONOMIC CHALLENGE WITH THE FORMATION OF SEMATECH.

WITH SEMATECH, THE U.S. GOVERNMENT HAS SENT A STRONG SIGNAL AROUND THE WORLD THAT WE ARE WILLING AS A NATION TO TAKE SUCH COMPETITIVE STEPS IN CRITICAL INDUSTRIES. AND WHILE SEMATECH IS UNIQUE IN ITS INDUSTRY-GOVERNMENT PARTNERSHIP IN THIS COUNTRY, IT IS NOT UNIQUE IN ITS COOPERATIVE SPIRIT. AMERICA HAS A RICH HISTORY OF PUTTING DIFFERENCES ASIDE AND WORKING TOGETHER FOR THE COMMON GOOD.

FROM BARN RAISINGS IN RURAL AMERICA TO THE PROGRAM THAT PUT THE FIRST MAN ON THE MOON, AMERICA HAS PROVEN TIME AND TIME AGAIN THAT TEAMWORK AND COOPERATION ARE AS AMERICAN AS HOT DOGS, BASEBALL, APPLE PIE AND CHEVROLETS, TO BORROW A PHRASE.

AT SEMATECH, WE HAVE 14 AMERICAN COMPANIES --EACH FIERCELY COMPETITIVE IN THE WORLD MARKETPLACE -- COMING TOGETHER TO SHARE KNOWLEDGE AND KNOW-HOW IN AN EFFORT TO RESTORE SEMICONDUCTOR MANUFACTURING LEADERSHIP TO AMERICA. SEMATECH'S ONLY PRODUCT -- KNOWLEDGE -- IS SHARED WITH OUR MEMBER COMPANIES, WHO TAKE THAT KNOWLEDGE AND PUT IT TO USE AGAINST THEIR FELLOW SEMATECH COMPANIES, OTHER AMERICAN FIRMS, AND, MORE IMPORTANTLY, AGAINST OUR FOREIGN COMPETITION. COMPETITION IS THE CATALYST THAT DRIVES AMERICA'S FREE ENTERPRISE SYSTEM. AS A NATION, WE VALUE AND WELCOME COMPETITION. NO DOUBT, JAPAN IS A COMPETITIVE NATION.

WE SHOULD TAKE PRIDE IN THE ROLE WE PLAYED IN MAKING THAT STATEMENT TRUE. BUT WE SHOULD ALSO TAKE CARE TO ASSURE THAT WE CREATE AN ENVIRONMENT IN THIS COUNTRY THAT ALLOWS AMERICA TO BE JUST AS COMPETITIVE. AS A NATION, WE HAVE ALWAYS RESPONDED TO COMPETITION. THE RECOMMENDATIONS IN THE NATIONAL ADVISORY COMMITTEE ON SEMICONDUCTORS CONTAIN SOME VERY GOOD SUGGESTIONS.

I JUST HOPE IT DOESN'T TAKE A BARN BURNING ... OR ANOTHER SPUTNIK ... FOR US TO RESPOND THIS TIME.

THANK YOU.

Senator GORE. Thank you very much, Mr. Mills. I will come back with questions at the conclusion of the panel.

Our next witness is Mr. Mitchell Kertzman, President and CEO of Powersoft Corporation, speaking today on behalf of the American Electronics Association based in Washington.

Again speaking for others as well, Mr. Kertzman, may I say that I have been most impressed with the way in which your association has moved out to alert the country to some of these problems and really play a leadership role. We look

STATEMENT OF MITCHELL E. KERTZMAN, PRESIDENT AND CHIEF EXECUTIVE OFFICER, POWERSOFT CORP. BURLINGTON, MA, ON BEHALF OF THE AMERICAN ELECTRONICS ASSN.

Mr. KERTZMAN. Thank you, Mr. Chairman. We also appreciate your passion for these issues, and I want to thank Mr. Mills for doing the difficult job of bringing you out of your shell this morning to comment. [Laughter.]

Mr. KERTZMAN. I am here testifying today on behalf of the American Electronics Association which, as you know, represents over 3,000 American electronics and information technology companies across our Nation.

The U.S. electronics industry trends that are highlighted in the Commerce Department's recent report are, we believe, ominous. Over all, the U.S. electronics industry is not keeping pace with foreign competitors in the global marketplace. It is becoming increasingly difficult for the small innovative, entrepreneurial enterprises that characterize the U.S. electronics industry to compete with powerful foreign competitors with fundamentally different methods and goals.

Now there are many who would argue that actions to improve the competitiveness of American firms are increasingly irrelevant in a global economy. This argument typically runs that there is no reason to worry about the health of the electronics infrastructure in the United States because we are in a global economy.

I recently testified on Senator Metzenbaum's subcommittee on antitrust modification for joint manufacturing ventures on a panel with Professor Porter of Harvard who took what I would characterize as a Pollyanna view of American competitiveness. His recent book, as you know, analyzed the competitiveness of 10 nations.

Now there are many elements of Professor Porter's thesis with which we strongly disagree, specifically his analysis of the structure of competition in Japan. Perhaps the most critical point he makes, however, is a seeming contradiction that rather than becoming less important in a global economy, the actions of nations and the domestic health and structure of an industry are actually more important than ever before.

Professor Porter writes, quoting, "The home base is the nation in which the essential competitive advantages of the enterprise are created and sustained. It is where a company's strategy is set, where the core product and process technology is created and maintained, and where the most productive jobs and most advanced skills are located."

Professor Porter contends that the fundamental determinants of national competition lie in something he calls the diamond of national advantage. One of the four points of this diamond, a critical factor in an industry's international competitiveness, is the absence or presence of an internationally competitive supplier and equipment base.

Now this point is especially important for the electronics industry. In our industry you can survive many things, but one thing you simply cannot survive is missing the window to bring a technology to market. Products are very complicated, and they stretch the limits of science. R&D cycles are exceptionally long, and product lives are becoming exceptionally short.

This dramatically heightens the importance of linkages between different segments of the industry. If you have access to a technology six months later than your major competitors, you do not lose just a few sales but you frequently destroy the entire economic feasibility of a complete product line. We usually describe this as the electronics food chain.

Now as the Commerce Department report underscores, the health of this food chain is in peril. In the last decade we have lost market share in scores of critical technologies. Looking to the future, the prognosis is not good.

Given the critical importance of technology to American world leadership and the mutually reinforcing role of individual industry segments, so well explained in the CSPP study, the AEA is deeply concerned as we see critical pieces of the industry disappear. The health of specific industry segments is important to the overall health of the electronics industry, and the quality of our infrastructure within the industry, within the government and within the financial community is important to our competitiveness as a Nation.

In keeping the U.S. electronics industry globally competitive, both industry and government have vital roles to play. Our challenge is to compete effectively with the combined efforts of foreign governments and industries while simultaneously fostering our innovative entrepreneurial companies that are America's strength. The Nation, both government and industry, has not yet responded successfully to this challenge.

Now much of what needs to be done is squarely up to private industry. AEA's members have undertaken a spectrum of activities to make their companies and the country more competitive. Our companies are aggressively pursuing foreign markets. We are increasing efforts to improve America's educational system, intensifying efforts to produce world class products and leveraging R&D investment through involvement with consortia, Federal research programs and universities, to name but a few industry efforts at improving competitiveness.

These activities alone, however, will not insure a competitive U.S. electronics industry. They must be complemented by Federal policies that are developed and administered with a goal of U.S. economic leadership. Congress and the administration must work together to insure that we have the fundamental building blocks of a world class technology industry. These are technology, brains, capital and markets.

More specifically, the Federal Government should:

Promote the commercialization of technology;

Provide a multiyear authorization bill and adequate funding for the National Institute of Standards and Technology and its advanced technology program;

Reform antitrust laws to encourage manufacturing joint ventures;

Provide a strong education and research infrastructure;

Follow through on your commitment to double the National Science Foundation's budget;

Establish a national high speed information infrastructure to support supercomputing and networking-related research and education;

Provide patient low cost capital;

Enact a permanent capital gains tax differential with preferential treatment for assets held for longer periods of time, what I call a real capital gains tax differential for productive investment;

Enact a permanent R&D tax credit and a permanent basic research credit;

Promote free and open markets;

Achieve successful conclusion of the GATT Uruguay Round;

Pursue resolution of bilateral agreements to open markets to U.S. export and investment;

Reform the U.S. export control system to place U.S. exporters on an equal basis with competitors from allied countries and minimize our regulatory burden; and

Significantly improve and strengthen our national export promotion infrastructure.

In conclusion, I would like to underscore a couple of key points.

First, U.S. leadership in technology is essential to U.S. world leadership. The health of the U.S. electronics infrastructure is critically important to the ability of U.S. companies to compete in world markets. I think the answers are clear. As you have pointed out, we have been doing our best to send a message. Reduce the cost of capital. Improve the education system. Identify better ways to focus government R&D dollars on precompetitive commercial technologies that encourage world class quality among U.S. manufacturers.

I believe that the problem is one of politics and leadership. The changes that are occurring in the world open up whole new areas of opportunity for this Nation. My concern and the evidence that we see all around us is that we simply lack the will to act and to act decisively to grab this opportunity before us.

Now there is one thing that we seem to lead the world in. We seem to lead the world on competitive studies. Mr. Chairman, I would like to see us lead the world in competitiveness. Thank you.

[The statement follows:]

STATEMENT OF MITCHELL E. KERTZMAN, ON BEHALF OF THE AMERICAN ELECTRONICS ASSN.

GOOD MORNING. MY NAME IS MITCHELL KERTZMAN. I AM PRESIDENT AND CEO OF POWERSOFT CORPORATION AND THE 1990 CHAIRMAN OF THE AMERICAN ELECTRONICS ASSOCIATION (AEA).

I AM HERE TODAY TESTIFYING ON BEHALF OF AEA, WHICH HAS MORE THAN 3,000 U.S. HIGH-TECH COMPANIES AS MEMBERS. AEA REPRESENTS THE SPECTRUM OF ELECTRONICS COMPANIES -- "FROM MATERIALS TO SYSTEMS" AS THE TITLE OF THE COMMERCE DEPARTMENT REPORT STATES. WE REPRESENT VIRTUALLY ALL OF THE TOP 200 ELECTRONICS COMPANIES. AT THE SAME TIME, 80 PERCENT OF OUR MEMBER COMPANIES HAVE FEWER THAN 200 EMPLOYEES. FIFTY PERCENT OF OUR MEMBERS HAVE LESS THAN 50 EMPLOYEES. AEA HAS COUNCILS IN 21 KEY HIGH-TECHNOLOGY CENTERS AROUND THE COUNTRY. I AM ALSO PLEASED TO NOTE THAT 55 U.S. RESEARCH UNIVERSITIES ARE ASSOCIATE MEMBERS OF AEA.

EARLY IN MY TERM AS AEA CHAIR, I TOURED THE COUNTRY VISITING EACH OF THE ASSOCIATION'S 21 CHAPTERS. THE MESSAGE I HEARD WAS ONE WITH WHICH I'M SURE EVERYONE HERE TODAY WOULD AGREE: THE COMPETITIVENESS OF THIS COUNTRY AND THE LONG-TERM SUCCESS OF U.S. COMPANIES FUNDAMENTALLY RESTS NOT WITH GOVERNMENT, BUT WITH THE MILLIONS AND MILLIONS OF INDIVIDUAL DECISIONS MADE EVERY DAY BY THOUSANDS AND THOUSANDS OF COMPANIES.

HOWEVER, I ALSO HEARD SOME OTHER THINGS. I HEARD FROM HUNDREDS OF COMPANIES DEEP IN THE INFRASTRUCTURE OF THE ELECTRONICS INDUSTRY THAT ARE CONCERNED ABOUT THE OVERALL HEALTH OF THE INDUSTRY AND THEIR LONG-TERM VIABILITY GIVEN THE WEAKENING CUSTOMER BASE. I HEARD FROM COMPANIES THAT USED TO THINK OF THEMSELVES AS SAFE "NICHE" COMPANIES, CONCERNED ABOUT THE NEW CHALLENGE OF DIRECT COMPETITION FROM THE JAPANESE. I HEARD FROM MANY SMALL COMPANIES THAT BEMOAN THE HIGH COST AND "IMPATIENCE" OF CAPITAL IN THIS COUNTRY, AND THE IMPACT THAT THIS HAS UPON THEIR ABILITY TO COMMERCIALIZE CUTTING-EDGE TECHNOLOGIES.

I ALSO HEARD VARIATIONS ON THE FAMILIAR QUOTATION BY BENJAMIN FRANKLIN THAT WE IN THE U.S. ELECTRONICS INDUSTRY MUST CERTAINLY WORK TO HANG TOGETHER, OR WE WILL JUST AS CERTAINLY HANG SEPARATELY. IT IS IN THAT CONTEXT THAT I WOULD LIKE TO ADDRESS THE COMMERCE DEPARTMENT REPORT AND THE CHALLENGES FACING THE ELECTRONICS INDUSTRY.

STRATEGIC IMPORTANCE OF ELECTRONICS INDUSTRY

A QUOTATION I HEARD IN WASHINGTON FROM THOSE WHO DO NOT UNDERSTAND THE UNIQUE ROLE TECHNOLOGY PLAYS IN THE ECONOMIC HEALTH OF THE U.S. IS "IT MAKES NO DIFFERENCE WHETHER THE UNITED STATES EXPORTS COMPUTER CHIPS OR POTATO CHIPS." THE DEPARTMENT OF COMMERCE REPORT SHOULD DISPEL THIS NOTION. THE REPORT CLEARLY DEMONSTRATES THAT THE U.S. ELECTRONICS INDUSTRY IS CRITICAL TO AMERICA'S ECONOMIC GROWTH AND NATIONAL SECURITY...AND THAT IT IS AN INDUSTRY UNDER SERIOUS THREAT TODAY.

IT IS IMPORTANT TO UNDERSTAND EXACTLY WHAT IS AT STAKE WHEN WE SPEAK OF THE U.S. ELECTRONICS INDUSTRY'S ERODING GLOBAL MARKET SHARE AND DECLINING TECHNOLOGICAL LEADERSHIP. ALLOW ME TO ELABORATE ON SOME OF THE COMMERCE DEPARTMENT'S STATISTICS.

NO OTHER MANUFACTURING INDUSTRY IN THE UNITED STATES EMPLOYS MORE PEOPLE. OVER 2.6 MILLION AMERICAN WORKERS ARE DIRECTLY EMPLOYED IN ELECTRONICS MANUFACTURING -- ONE OUT OF EVERY EIGHT U.S. MANUFACTURING JOBS IS IN ELECTRONICS. THAT IS THREE TIMES THE SIZE OF THE AUTO INDUSTRY, AND NINE TIMES THAT OF THE BASIC STEEL INDUSTRY.

NO OTHER MANUFACTURING INDUSTRY IN THE UNITED STATES HAS GROWN AS FAST AS THE ELECTRONICS INDUSTRY. IN 1989 TOTAL SALES OF ELECTRONICS PRODUCTS AND SERVICES OF U.S.-BASED COMPANIES REACHED $295 BILLION IN THE U.S., MORE THAN $420 BILLION WORLDWIDE. OVER THE PAST FIVE YEARS GROWTH RATES FOR THE ELECTRONICS INDUSTRY HAVE BEEN 50 PERCENT GREATER THAN THOSE OF THE ECONOMY AS A WHOLE.

NO OTHER MANUFACTURING INDUSTRY IN THE UNITED STATES MATCHES ELECTRONICS IN PRODUCTIVITY IMPROVEMENTS AND INNOVATION. BETWEEN 1977 AND 1986 VALUE ADDED PER PRODUCTION WORKER HOUR INCREASED BY 150 PERCENT IN ELECTRONICS. IN 1986, 36 PERCENT OF ALL U.S. PATENTS AWARDED WENT TO ELECTRONICS INVENTORS.

NO OTHER MANUFACTURING INDUSTRY IN THE UNITED STATES EXPORTS MORE THAN ELECTRONICS. 25 PERCENT OF U.S. ELECTRONICS INDUSTRY SALES IS FROM EXPORTS AND THE VALUE OF THESE EXPORTS HAS INCREASED AT AN AVERAGE RATE OF 18 PERCENT A YEAR SINCE 1977, REACHING ABOUT $39 BILLION IN 1987.

BUT WHAT IS PERHAPS MOST SIGNIFICANT ABOUT OUR INDUSTRY IS THAT IT PROVIDES THE TOOLS FOR WORKERS IN OTHER SEGMENTS OF THE ECONOMY TO BOOST THEIR PRODUCTIVITY AND COMPETITIVENESS. THE USE OF ELECTRONICS TECHNOLOGY HAS SPREAD WIDELY TO DISPARATE SECTORS OF U.S. BUSINESS AND INDUSTRY.

AS CHARLES FERGUSON OF MIT RECENTLY NOTED IN THE HARVARD BUSINESS REVIEW, ON THE SURFACE, ALL SEEMS FINE. "THE NUMBERS ARE DECEPTIVELY REASSURING."

U.S. INDUSTRY AND THE GLOBAL MARKET

THE U.S. ELECTRONICS INDUSTRY MAKES AN IMPRESSIVE SHOWING IN COMPARISONS WITH OTHER U.S. INDUSTRIES, BUT IF THE YARDSTICK IS FOREIGN COMPANIES AND GOVERNMENTS A DIFFERENT PICTURE EMERGES.

o A LOOK AT SPECIFIC INDUSTRY SECTORS INDICATES THAT STRATEGIC PIECES OF THE U.S. ELECTRONICS INDUSTRY HAVE EXPERIENCED MAJOR LOSSES IN MARKET SHARE OVER THE PAST FEW YEARS.

o FROM 1984 TO 1987 U.S. MARKET SHARE IN SILICON WAFERS WENT FROM 85% TO 22%; SEMICONDUCTORS...FROM 54% TO 41%; COMPUTERS....78% TO 69%; THE TABLE ON PAGE 17 OF THE COMMERCE DEPARTMENT'S REPORT DRAWS A BLEAK PICTURE.

o IN THE PAST DECADE ALONE, THERE HAS BEEN A $20 BILLION SWING IN THE ELECTRONICS TRADE BALANCE.

o IN 1989, THE U.S. FOR THE FIRST TIME BECAME A NET IMPORTER OF COMPUTERS. OUR COMPUTER TRADE BALANCE WITH JAPAN GREW TO A $6 BILLION DEFICIT IN 1988 AND CONTINUES TO GROW.

o SINCE 1972 JAPANESE MANUFACTURING PRODUCTIVITY HAS RISEN BY 120 PERCENT, COMPARED WITH APPROXIMATELY 49 PERCENT INCREASE FOR THE U.S.

o LAST YEAR, FOR THE FIRST TIME EVER, JAPAN OUTSPENT THE U.S. IN INVESTMENT IN PLANT AND EQUIPMENT -- ON A PER CAPITA BASIS JAPAN SPENDS MORE THAN TWICE AS MUCH AS U.S. INDUSTRY.

o BETWEEN 1975 AND 1986 FOREIGN SHARE OF U.S. PATENTS INCREASED FROM 34 PERCENT TO 47 PERCENT. LAST YEAR THE TOP FIVE RECIPIENTS OF U.S. PATENTS WERE HITACHI, TOSHIBA, CANON, GE, AND FUJI.

EVEN THE INDUSTRY SEGMENTS THAT THE U.S. DOMINATES CANNOT BE TAKEN FOR GRANTED BECAUSE OF DOWNWARD TRENDS IN THE GLOBAL MARKETPLACE. BETWEEN 1981 AND 1985, THE U.S. SOFTWARE INDUSTRY GREW AT A COMPOUNDED ANNUAL RATE OF 88 PERCENT. IT IS ESTIMATED TO GROW AT ONLY 13 PERCENT PER YEAR DURING THE PERIOD FROM 1987 TO 1991. AND THE SAME IS TRUE FOR PERSONAL COMPUTERS. THIS INDUSTRY SEGMENT GREW 74 PERCENT BETWEEN 1981 AND 1985 AND ONLY A PROJECTED 9 PERCENT FROM 1987 TO 1991.

OVERALL, THE U.S. ELECTRONICS INDUSTRY IS NOT KEEPING PACE WITH FOREIGN COMPETITORS IN THE GLOBAL MARKETPLACE. IT IS BECOMING INCREASINGLY DIFFICULT FOR THE SMALL, INNOVATIVE, ENTREPRENEURIAL ENTERPRISES THAT CHARACTERIZE THE U.S. ELECTRONICS INDUSTRY TO COMPETE WITH POWERFUL FOREIGN COMPETITORS WITH FUNDAMENTALLY DIFFERENT METHODS AND GOALS.

THE REAL WORLD

I WOULD LIKE TO OFFER A FEW GENERALIZATIONS ABOUT THE STRUCTURE OF JAPANESE COMPANIES THAT ILLUSTRATE HOW THE REAL WORLD IS FAR DIFFERENT FROM THE IDEALIZED WORLD SUGGESTED IN SEVERAL RECENT STUDIES:

o VIRTUALLY ALL OF JAPAN'S TOP CITY BANKS, TRUST BANKS, INSURANCE COMPANIES, AND COMPUTER, TELECOMMUNICATIONS, AND SEMICONDUCTOR COMPANIES ARE MEMBERS OF ONE OF SIX FINANCIAL KEIRETSU. THESE KEIRETSU ARE CHARACTERIZED BY INTERLOCKING

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DIRECTORATES AND SHARED FINANCIAL HOLDINGS. OFTEN AS MUCH AS 30 PERCENT OF THE TOTAL SHARES OUTSTANDING ARE HELD BY GROUP MEMBERS.

- THESE SIX KEIRETSU GIVE THEIR MEMBER COMPANIES -- WHICH ARE OFTEN INDIVIDUALLY FAR LARGER THAN U.S. COMPANIES -- ACCESS TO THE KIND OF DEEP-POCKETS, AND PATIENT CAPITAL NEEDED FOR ADVANCED TECHNOLOGY. REPRESENTATIVES FROM EACH OF THESE KEIRETSU COMPETE VIGOROUSLY AGAINST EACH OTHER, BUT RARELY WITHIN A PARTICULAR KEIRETSU.

- FOR EXAMPLE, EACH OF THE MEMBER COMPANIES OF THE SUMITOMO (SMT) KEIRETSU WOULD BE LARGE COMPANIES IN THE U.S. IN ITS OWN RIGHT. NEC -- THE ELECTRONICS COMPANY IN THE SUMITOMO KEIRETSU -- IS ITSELF A $25 BILLION COMPANY. SMT METAL INDUSTRIES, $10 BILLION. SMT CHEMICAL, $7 BILLION. SMT ELECTRIC, $7 BILLION. SMT RUBBER, $3 BILLION. SMT HEAVY INDUSTRIES, $3 BILLION. THAT'S 6 ENTRIES IN THE FORTUNE GLOBAL 500 FROM A SINGLE KEIRETSU. ALL TOLD, ACCORDING TO AEA'S JAPAN OFFICE THERE ARE 111 COMPANIES IN THE SUMITOMO KEIRETSU, WITH OVER 500,000 EMPLOYEES AND OVER $350 BILLION IN ANNUAL SALES. THAT'S WHAT WE'RE UP AGAINST.

- IN ADDITION, EACH MAJOR JAPANESE MANUFACTURER ACTS AS HEAD OF A MAJOR SUPPLY KEIRETSU, WHICH SERVE A LARGE COMPANY AND MULTIPLE LEVELS OF SUPPLIERS. AGAIN A SIGNIFICANT PART OF THE BUSINESS OF THESE GROUPS IS DONE IN CONJUNCTION WITH OTHER MEMBERS OF THE GROUP.

- FINALLY, I SHOULD ADD THAT THIS ONLY ADDRESSES THE KIND OF COOPERATION THAT RESULTS PURELY FROM THE NATURE OF THE BUSINESS STRUCTURE IN JAPAN. THIS DOES NOT ADDRESS THE ROLE THAT MITI AND OTHER AGENCIES OF THE JAPANESE GOVERNMENT PLAY WITHIN THIS OVERALL SYSTEM.

JAPAN'S BUSINESS STRUCTURE

JAPAN'S BUSINESS STRUCTURE IS ONE RESPONSE TO SOME VERY REAL CONSOLIDATION PRESSURES WITHIN THE ELECTRONICS INDUSTRY STEMMING FROM:

- THE SIZE AND VOLATILITY OF GLOBAL MARKETS. DURING THE 1980s, BOTH JAPANESE AND U.S. SEMICONDUCTOR COMPANIES LOST BILLIONS OF DOLLARS. HUGE JAPANESE COMPANIES WITH DEEP POCKETS AND OPERATING IN THE KIND OF STRUCTURAL ENVIRONMENT I DESCRIBED EARLIER COULD SURVIVE THIS LOSS AND CLAIM MARKET SHARE. MOST U.S. COMPANIES COULD NOT.

- THE INCREASING COST OF INVESTMENT IN NEXT GENERATION TECHNOLOGY. FIFTEEN YEARS AGO, THE ORIGINAL TOOL THAT DREW THE CIRCUIT PATTERN ONTO CHIPS -- A CONTACT PRINTER -- COST

$35,000. TODAY, THIS PROCESS HAS BEEN AUTOMATED WITH 10-50 "STEPPERS," EACH OF WHICH COST $1.7 MILLION. IN THE NEXT FEW YEARS, CHIP MANUFACTURING WILL REQUIRE A NEW PROCESS CALLED X-RAY LITHOGRAPHY. $1 BILLION HAS BEEN INVESTED BY IBM IN THE ONLY PRODUCTION FACILITY FOR THIS TECHNOLOGY IN THIS COUNTRY. THERE ARE 19 SIMILAR PROJECTS UNDERWAY IN JAPAN.

WE DO NOT NEED -- OR WANT -- TO DUPLICATE THE JAPANESE STRUCTURE TO RESPOND TO THESE VERY REAL MARKET AND TECHNOLOGY CHALLENGES. INSTEAD, WE MUST FASHION SOLUTIONS THAT TAKE ADVANTAGE OF U.S. STRENGTHS IN THE GLOBAL MARKETPLACE.

HOME BASE SUSTAINS COMPETITIVE ADVANTAGE

THERE ARE MANY WHO WOULD ARGUE THAT ACTIONS TO IMPROVE THE COMPETITIVENESS OF U.S. FIRMS ARE INCREASINGLY IRRELEVANT IN A GLOBAL ECONOMY. THE ARGUMENT TYPICALLY RUNS, "WHY DOES IT MATTER WHO IS A WORLD LEADER IN SEMICONDUCTORS? WE ARE NOW IN A GLOBAL ECONOMY. THERE IS NO REASON TO WORRY ABOUT THE HEALTH OF THE ELECTRONICS INFRASTRUCTURE IN THE UNITED STATES IF WE'RE IN A GLOBAL ECONOMY."

IN HIS RECENT BOOK, PROFESSOR MICHAEL PORTER OF HARVARD ANALYZES THE COMPETITIVENESS OF 10 NATIONS. THERE ARE SOME ELEMENTS OF MR. PORTER'S THESIS WITH WHICH WE STRONGLY DISAGREE -- SPECIFICALLY HIS ANALYSIS OF THE STRUCTURE OF COMPETITION IN JAPAN. HOWEVER, PERHAPS THE MOST CRITICAL POINT HE MAKES IS THE SEEMING CONTRADICTION THAT RATHER THAN BECOMING LESS IMPORTANT IN A GLOBAL ECONOMY, THE ACTIONS OF NATIONS AND THE DOMESTIC HEALTH AND STRUCTURE OF AN INDUSTRY ARE ACTUALLY MORE IMPORTANT THAN EVER BEFORE.

RATHER THAN TRY TO PARAPHRASE MR. PORTER, I WANT TO USE A QUICK QUOTE TO ILLUSTRATE THIS POINT: "THE HOME BASE IS THE NATION IN WHICH THE ESSENTIAL COMPETITIVE ADVANTAGES OF THE ENTERPRISE ARE CREATED AND SUSTAINED. IT IS WHERE A COMPANY'S STRATEGY IS SET, WHERE THE CORE PRODUCT AND PROCESS TECHNOLOGY IS CREATED AND MAINTAINED, AND WHERE THE MOST PRODUCTIVE JOBS AND MOST ADVANCED SKILLS ARE LOCATED. THE PRESENCE OF THE HOME BASE IN A NATION HAS THE GREATEST POSITIVE INFLUENCE ON OTHER LINKED DOMESTIC INDUSTRIES AND LEADS TO OTHER BENEFITS IN THE NATION'S ECONOMY."

MR. PORTER CONTENDS THAT THE FUNDAMENTAL DETERMINANTS OF NATIONAL COMPETITION LIE IN SOMETHING HE CALLS THE "DIAMOND OF NATIONAL ADVANTAGE." ONE OF THE FOUR POINTS OF THIS DIAMOND -- A CRITICAL FACTOR IN AN INDUSTRY'S INTERNATIONAL COMPETITIVENESS -- IS THE ABSENCE OR PRESENCE OF AN INTERNATIONALLY COMPETITIVE SUPPLIER AND EQUIPMENT BASE.

THIS POINT IS ESPECIALLY IMPORTANT FOR THE ELECTRONICS INDUSTRY. IN OUR INDUSTRY, YOU CAN SURVIVE MANY THINGS, BUT ONE THING YOU

CANNOT SURVIVE IS MISSING THE "WINDOW" TO BRING A TECHNOLOGY TO MARKET. PRODUCTS ARE EXTREMELY COMPLICATED AND STRETCH THE LIMITS OF SCIENCE. R&D CYCLES ARE EXCEPTIONALLY LONG. PRODUCT LIVES ARE VERY SHORT.

THIS DRAMATICALLY HEIGHTENS THE IMPORTANCE OF LINKAGES BETWEEN DIFFERENT SEGMENTS OF THE INDUSTRY. IF YOU HAVE ACCESS TO A TECHNOLOGY 6 MONTHS LATER THAN A MAJOR COMPETITOR, YOU DON'T JUST LOSE A FEW SALES, YOU FREQUENTLY DESTROY THE ECONOMIC FEASIBILITY OF AN ENTIRE PRODUCT LINE. WE USUALLY DESCRIBE THIS AS THE "ELECTRONICS FOOD CHAIN".

AS THE COMMERCE DEPARTMENT REPORT UNDERSCORES, THE HEALTH OF THIS FOOD CHAIN IS IN PERIL. IN THE LAST DECADE, WE HAVE LOST MARKET SHARE IN SCORES OF CRITICAL TECHNOLOGIES. LOOKING TO THE FUTURE, THE PROGNOSIS IS NOT GOOD. ANOTHER RECENT REPORT FROM THE DEPARTMENT OF COMMERCE CONCLUDES THAT WE ARE "LOSING" TO JAPAN IN ADVANCED SEMICONDUCTOR DEVICES, IN HIGH-DENSITY STORAGE, IN HIGH-PERFORMANCE COMPUTING, IN MEDICAL DEVICES AND DIAGNOSTICS, IN OPTOELECTRONICS, AND IN SENSOR TECHNOLOGY. WE ARE "LOSING BADLY" IN ADVANCED MATERIALS, BIOTECH, DIGITAL IMAGING TECHNOLOGY, AND SUPERCONDUCTORS.

GIVEN OUR EARLIER POINTS -- THE CRITICAL IMPORTANCE OF TECHNOLOGY TO U.S. WORLD LEADERSHIP AND THE MUTUALLY REINFORCING ROLE OF INDIVIDUAL INDUSTRY SEGMENTS -- THE AEA IS DEEPLY CONCERNED AS WE SEE CRITICAL PIECES OF THE INDUSTRY DISAPPEAR. THE HEALTH OF SPECIFIC INDUSTRY SEGMENTS IS IMPORTANT TO THE OVERALL HEALTH OF THE ELECTRONICS INDUSTRY. AND THE QUALITY OF OUR INFRASTRUCTURE -- WITHIN THE INDUSTRY, WITHIN THE GOVERNMENT, AND WITHIN THE FINANCIAL COMMUNITY -- IS IMPORTANT TO OUR COMPETITIVENESS AS A NATION.

IN KEEPING THE U.S. ELECTRONICS INDUSTRY GLOBALLY COMPETITIVE, BOTH INDUSTRY AND GOVERNMENT HAVE VITAL ROLES TO PLAY. OUR CHALLENGE IS TO COMPETE EFFECTIVELY WITH THE COMBINED EFFORTS OF FOREIGN GOVERNMENTS AND INDUSTRIES WHILE SIMULTANEOUSLY FOSTERING OUR INNOVATIVE, ENTREPRENEURIAL COMPANIES THAT ARE AMERICA'S STRENGTH. THE NATION, BOTH GOVERNMENT AND INDUSTRY, HAS NOT YET RESPONDED SUCCESSFULLY TO THIS CHALLENGE.

INDUSTRY ROLE

MUCH OF WHAT NEEDS TO BE DONE IS SQUARELY UP TO PRIVATE INDUSTRY. AEA'S MEMBERSHIP HAS UNDERTAKEN A VARIETY OF ACTIVITIES TO MAKE THEIR COMPANIES -- AND THE COUNTRY -- MORE COMPETITIVE. FOR EXAMPLE:

- COMPANIES ARE AGGRESSIVELY PURSUING FOREIGN MARKETS. AEA HAS AN OFFICE IN TOKYO TO ASSIST SMALL AND MEDIUM SIZE COMPANIES GAIN ACCESS TO JAPAN'S TECHNOLOGY AND MARKETS.

AEA HAS UNDERTAKEN A NUMBER OF INITIATIVES IN COOPERATION WITH THE DEPARTMENT OF COMMERCE TO PREPARE COMPANIES TO COMPETE IN A SINGLE EUROPEAN MARKET IN 1992. UNDER A DOC DEVELOPMENT GRANT, WE ARE EXPLORING PLACING A FULL TIME PRESENCE IN EUROPE TO HELP COMPANIES DO BUSINESS IN THE NEW SINGLE MARKET.

- THE ELECTRONICS INDUSTRY HAS A RENEWED COMMITMENT TO PRODUCING WORLD CLASS QUALITY PRODUCTS. COMPANIES SUCH AS MOTOROLA, WINNER OF THE MALCOLM BALDRIDGE QUALITY AWARD, HAVE DEMONSTRATED A COMMITMENT TO WORLD CLASS MANUFACTURING.

- THE ELECTRONICS INDUSTRY CONTINUES TO PLAY AN IMPORTANT ROLE IN IMPROVING AMERICA'S EDUCATIONAL SYSTEM. THIS YEAR AEA LAUNCHED A NEW NATIONAL K-12 INITIATIVE TO ENHANCE THE MATH AND SCIENCE SKILLS OF AMERICA'S YOUTH. THIS COMPLEMENTS AEA'S TEN YEAR EFFORT TO STRENGTHEN SCIENCE AND ENGINEERING EDUCATION AND RESEARCH AT THE UNIVERSITY LEVEL.

- COMPANIES ARE WORKING ON NEW WAYS TO DEVELOP COMMERCIAL USES OF MILITARY TECHNOLOGIES IN ANTICIPATION OF REDUCTIONS IN DEFENSE SPENDING.

- AEA IS ENCOURAGING THE FORMATION OF LONG-TERM STRATEGIC ALLIANCES BETWEEN SYSTEMS COMPANIES AND SUPPLIERS.

- COMPANIES ARE LEVERAGING R&D INVESTMENTS THROUGH PARTICIPATION IN CONSORTIA AND INVOLVEMENT WITH UNIVERSITIES AND FEDERAL RESEARCH PROGRAMS.

THESE ACTIVITIES ALONE, HOWEVER, WILL NOT ENSURE A COMPETITIVE U.S. ELECTRONICS INDUSTRY. THEY MUST BE COMPLEMENTED BY FEDERAL POLICIES THAT ARE DEVELOPED AND ADMINISTERED WITH THE GOAL OF U.S. ECONOMIC LEADERSHIP. CONGRESS AND THE ADMINISTRATION MUST WORK TOGETHER TO:

- <u>PROMOTE THE COMMERCIALIZATION OF TECHNOLOGY</u> -- PROVIDE A MULTI-YEAR AUTHORIZATION BILL AND ADEQUATE FUNDING FOR THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY AND ITS ADVANCED TECHNOLOGY PROGRAM. THESE PROGRAMS WILL HELP COMPANIES TRANSLATE NEW TECHNOLOGIES INTO EFFICIENTLY MANUFACTURED, HIGH QUALITY U.S. PRODUCTS. REFORM ANTITRUST LAWS TO ENCOURAGE MANUFACTURING JOINT VENTURES.

- <u>PROVIDE A STRONG EDUCATION AND RESEARCH INFRASTRUCTURE</u> -- FOLLOW THROUGH ON YOUR COMMITMENT TO DOUBLE THE NATIONAL SCIENCE FOUNDATION'S BUDGET. ESTABLISH A NATIONAL HIGH SPEED INFORMATION INFRASTRUCTURE TO SUPPORT SUPERCOMPUTING AND NETWORKING RELATED RESEARCH AND EDUCATION.

- <u>PROVIDE PATIENT LOW-COST CAPITAL</u> -- ENACT A PERMANENT CAPITAL GAINS TAX DIFFERENTIAL WITH PREFERENTIAL TREATMENT

FOR ASSETS HELD FOR LONGER PERIODS OF TIME. ENACT A PERMANENT R&D TAX CREDIT AND A PERMANENT BASIC RESEARCH CREDIT.

- PROMOTE FREE AND OPEN MARKETS -- ACHIEVE SUCCESSFUL CONCLUSION OF THE GATT URUGUAY ROUND, INCLUDING SIGNIFICANT STRENGTHENING OF THE INTELLECTUAL PROPERTY PROTECTION, STRENGTHENING OF THE DUMPING CODE, REMOVAL OF TARIFFS, AND HARMONIZED RULES OF ORIGIN. PURSUE RESOLUTION OF BILATERAL AGREEMENTS TO OPEN MARKETS TO U.S. EXPORT AND INVESTMENT. REFORM THE U.S. EXPORT CONTROL SYSTEM TO PLACE U.S. EXPORTERS ON EQUAL BASIS WITH COMPETITORS FROM ALLIED COUNTRIES AND MINIMIZE THE REGULATORY BURDEN. SIGNIFICANTLY IMPROVE AND STRENGTHEN OUR NATIONAL EXPORT PROMOTION INFRASTRUCTURE.

TECHNOLOGY, BRAINS, CAPITAL, AND MARKETS...THESE ARE THE FUNDAMENTAL BUILDING BLOCKS OF A WORLD-CLASS TECHNOLOGY INDUSTRY.

CONCLUSION

IN CONCLUSION, I WOULD LIKE TO UNDERSCORE A COUPLE OF POINTS:

- U.S. LEADERSHIP IN TECHNOLOGY IS ESSENTIAL TO LONG-TERM U.S. WORLD LEADERSHIP.
- THE HEALTH OF THE U.S. ELECTRONICS INFRASTRUCTURE IS CRITICALLY IMPORTANT TO THE ABILITY OF US COMPANIES TO COMPETE IN WORLD MARKETS.
- THE ANSWERS ARE CLEAR -- REDUCE THE COST OF CAPITAL, IMPROVE THE EDUCATIONAL SYSTEM, IDENTIFY BETTER WAYS TO FOCUS GOVERNMENT R&D DOLLARS ON PRE-COMPETITIVE COMMERCIAL TECHNOLOGIES, AND ENCOURAGE WORLD-CLASS QUALITY AMONG US MANUFACTURERS.

THE PROBLEM IS ONE OF POLITICS AND LEADERSHIP. THE CHANGES THAT ARE OCCURRING IN THE WORLD OPEN UP WHOLE NEW AREAS OF OPPORTUNITY FOR THIS NATION. MY CONCERN IS THAT WE LACK THE WILL TO ACT -- AND ACT DECISIVELY -- TO GRAB THE OPPORTUNITY BEFORE US. WE SEEM TO LEAD THE WORLD IN COMPETITIVENESS STUDIES. I WOULD RATHER LEAD THE WORLD IN COMPETITIVENESS.

Senator GORE. That was very good. I certainly appreciate that.

Is it fair to say that the U.S. electronics industry can be looked at as having three large divisions, firms which manufacture electronic systems such as computers, telecommunications equipment and consumer products, number 1, firms that manufacture components and devices, including those who make semiconductor chips, number 2, and firms that supply manufacturing equipment and materials, number 3, and that these three groups are all closely intertwined and that the health of each depends on the health of the others? Is that fair, or would you change that around a little bit?

It is absolutely fair. It is what we refer to as the electronics food chain. The only thing I would change about that is, I would add a fourth tier for my own industry, which is the software industry, in that, on top of the food chain.

Not in priority or importance, necessarily, but at the end of it—at the end of this chain—is software. You take these systems and they actually put them to work to solve people's problems. That is software systems integration, et cetera.

So that food chain goes from materials and equipment, as you said, right through the components and tools and up through systems into software, and every link of that chain is vitally important, and the break in any link, particularly as we talk about Semi-Gas, to the very materials on which it is based, and you have a house of cards.

Senator GORE. Very good. Our final witness on this panel is speaking on behalf of the Semiconductor Equipment and Materials International group. Mr. Louis Perrone is himself President of Branson International Plasma Corporation, and speaking on behalf of this trade group. We are very pleased to have you round at the panel, Mr. Perrone. If you would

STATEMENT OF LOUIS PERRONE, PRESIDENT, BRANSON INTERNATIONAL PLASMA CORPORATION, ON BEHALF OF SEMICONDUCTOR EQUIPMENT AND MATERIALS INTERNATIONAL

Mr. PERRONE. Thank you, Mr. Chairman, even though you have taken part of my presentation away from me already—the intertwining of the industry.

Senator GORE. I am sorry about that.

Mr. PERRONE. No, that is okay.

IPC is a manufacturer of silicon wafer fabrication equipment, for clarification.

Senator GORE. Would you move the microphone a little bit closer to you, please? Thank you.

Mr. PERRONE. It is also a wholly-owned subsidiary of the Emerson Electric Corporation in St. Louis, Missouri, which is a large, multi-national corporation supplying electronic products and systems.

I appreciate the opportunity to speak to you today. As you mentioned, I am a member of SEMI's Government Relations Committee. I am also a member of the Industry Sector Advisory Committee on trade policy matters at the Department of Commerce for science and electronics, sometimes known as ISAC 5.

I would like to focus today on four main ISSUES. the current status of the U.S. semiconductor industry and its supplier base, the ULSI fabrication and facilities business that Dr. Fuller spoke about and its impact on the overall decline of the U.S. electronics industry; secondly, Government private sector initiatives to address the technological problems in the industry; third, Government and private sector initiatives to address the investment problems in the industry; and finally, Government initiatives to encourage and, as is the case in the industry, sometimes discourage, exports.

The semiconductor device industry and the semiconductor equipment and materials industry in the United States essentially comprise one large, vital U.S. electronics base. Although distinctive in many ways, their fates are very much intertwined. A robust U.S. semiconductor industry has generally meant a healthy U.S. semiconductor production equipment and materials base, and vice versa.

Throughout the 1980's, as has been well documented in the Commerce Department report on the competitive status of the U.S. electronics industry, and in particular the U.S. semiconductor industry, we have begun to lose market share in key electronics sectors to foreign competition. This decline in market share and in some cases technological leadership is certainly apparent in many areas, such as memory device production and advanced materials development.

In our industry overall, U.S. world market share has fallen from 80 percent in the early 1980's to 45 percent in 1989. The July 12 report of the National Advisory Committee on Semiconductors, better known as the NACS, provides a good overview of the trends in our industry relative to market share and technological leadership.

Overall, their assessment is a sobering one. U.S. market share in lithography, a keystone technology sector which drives the development of advanced semiconductor manufacturing, has fallen precipitously from over 70 percent in 1983 to less than 40 percent in 1988, according to the report.

Materials such as silicon and polysilicon are still produced in the United States, but the vast majority of firms is foreign-owned, and it is not clear what that will mean for technological development or control of new technologies in the future.

These trends are extremely significant for our industry, as well as for our customer base. The linkages between national leadership and semiconductor manufacturing tools and materials and semiconductor device production are readily apparent.

In Japan, Government and industry have devoted significant resources and an intense effort to build a first- class domestic semiconductor equipment and materials infrastructure.

Although the industry is a high-growth one, I am sure that this is not the main reason the Japanese have made this investment. Instead, they have recognized the need to participate actively in the development of manufacturing tools and materials in order to ensure a technological edge in production.

The investment has already yielded substantial benefits, as they now comprise 6 of the top 10 merchant semiconductor producers in the world and control 31 percent of the world market for these products. This in turn has fueled the Japanese growth in computers, telecommunications and other sectors of the electronics industry.

The NACS report provides a summary of some of the reasons for the decline in U.S. leadership in both the semiconductor and semiconductor production equipment and materials. In our industry, escalating R&D costs, cyclical market trends, lack of low-cost investment capital and the generally small and often fragmented structure of the industry are often seen as the main factors undermining our strength. However, perhaps the greatest factor of all is the decline of our local customer base and the risks and high costs of depending heavily on sales in international markets.

Poor communication in the U.S. between the semiconductor device manufacturers and local equipment and materials suppliers has also been a factor. In Japan, the relationship between companies in these two sectors is close and cooperative.

One of the main goals of SEMATECH is to develop such close cooperation between the upstream supplier and the device producers. We still have a long way to go, but I believe we have recognized the problem and are working on it not only through SEMATECH but also individually and through other ventures. For example, IPC, a relatively small company, is working with four other equipment companies to integrate our products, to add value and increase competitiveness.

After reviewing these trends, however, the question remains, how should we as a Nation and as an industry respond? First, it is apparent that it is not too late to address these problems. As the NACS report indicates, the trends are not all bad. There are many excellent companies in our industry.

U.S. companies have held their own against powerful global competitors in new deposition and etch technologies. In addition, many of our companies, despite their predominantly small size, have proven their metal at penetrating foreign markets and exporting their product successfully. Branson IPC is a good example.

With a shrinking U.S. customer base and the growing importance and size of the Japanese, Korean, Taiwanese and other markets, we have had to turn to international markets to prosper.

Now let us discuss some Government-industry initiatives in technology. The United States once depended on military technology to fuel product innovation

in the commercial arena. This is no longer the case. The commercial arena and the products it develops are now the technology drivers, not weapons and defense-specific research. This change, however, is not reflected in our national research and development funding priorities.

I believe the U.S. Government, especially the Department of Defense, must change its policy and recognize the importance of industrial research and development as it relates to our national security. I concur with Ted Sorensen, who said recently, any significant U.S. expansion of investment in new product research and development will require a recognition of their importance to our national security. He goes on to state that it is folly to continue to target Federal R&D funds almost exclusively toward military applications.

With the potential of significantly-reduced military threat to our national security, it is time we began to address the economic threat. A fortress America is not required any longer. What is required is a healthy, competitive industrial base.

The U.S. Government devotes too much revenue to R&D which is self-serving only to the Defense establishment and the big science community. A larger proportion of our Government R&D dollar needs to be devoted to civilian or dual-use R&D which will improve the standard of living and aid the private sector in waging competitive battles in the global marketplace.

In May, in testimony before the Science Subcommittee a member of our industry, Moshe Lubin of Hampshire Industries, proposed the creation of test-bed projects to test and refine promising technologies. This idea is a promising one, but can only succeed if it is well-funded.

The Commerce Department's advanced technology program could also fuel such precompetitiveness, but also it must be properly resourced. Furthermore, more of the Federal research dollar must be concentrated into fewer jurisdictions if we are to be effective. This will result in more focused programs with pay-offs in the foreseeable future, not sometime in the middle of the next century.

In our industry, there are many promising new technologies which could have a significant impact on the long-term competitiveness of the U.S. semiconductor industry, but the escalating costs of R&D, now averaging, for the industry, over 16 percent of sales according to the NACS report, and the emphasis on short-term investment returns in the financial community, have made it difficult for companies to take risks and invest sufficiently in these new technologies.

Even SEMATECH is only a drop in the bucket toward what is needed to ensure U.S. presence in most semiconductor manufacturing technologies, given the deep pockets and long- term strategies of many of our foreign competitors. Unless the U.S. Government is willing to assist the industry to meet this R&D challenge, we may witness a further decline in some pivotal technologies. The need for increased Federal support for these sectors is not an attractive concept in time of fiscal crisis, but the long-term benefits for the U.S. economy and our national security may be substantial.

Investment. Direct funding is of course only one method of addressing the capital shortage in our industry. The Government can, instead, choose to play an increasing role in spurring private sector investment and R&D through the tax code. Several tax changes are especially critical for our industry, where R&D expenditures are extraordinarily high and product life cycles extremely short, typically averaging 3 years or less for advanced manufacturing products.

Immediate revision of the R&D tax credit to increase its effectiveness and make it permanent as recommended by the NACS is required. The current R&D credit formula provides no incentive to sustain R&D at high levels. The bottom line is that without R&D tax incentives to invest, along with the requirement of

a return on the investment, the numbers just do not add up for many companies. Therefore, the Government needs to encourage R&D activities by establishing a permanent R&D tax credit based not on incremental expenditures but on total annual R&D expenditures as recommended in the NACS report. Further, we would recommend that depreciation schedules for advanced semiconductor equipment be reassessed and shortened to reflect more accurately the short product life cycles in our industry.

Finally, our customers need an incentive to spur capital spending, especially on our new products. In this case, we also agree with NACS in supporting a 50 percent investment tax credit for new products purchased in the first year of production. This precompetitive incentive will improve the overall competitiveness of the fundamental industries supporting the U.S. electronics base.

Lastly, a bipartisan realistic initiative to balance the Federal budget is required. The Government's financing needs place it in a role where it competes too widely with the private sector for a limited amount of capital, thus reducing the total available for the private sector.

A significant reduction and eventual elimination of the fiscal deficit will spur capital availability for investment, and spur reduction in the cost of capital. However, But if the Federal Government continues to increase its dependence on deficit financing, the effect on our industrial base and national well being could be devastating.

The American people are willing to share their fair burden of deficit reduction. Now the Congress and administration must cooperate in a realistic effort to reduce and hopefully eliminate the Federal deficit.

I mentioned earlier the importance of export markets to our industry's survival. My company, for example, depends on exports for over half of our total revenue in most years. In the 1980's, it has been all years. We do not see this dependence on exports declining. As a result, one of the issues I wanted to discuss is U.S. export controls, and their continuing negative impact on our export-oriented industry.

For too many years our industry has been excessively controlled under the U.S. export control regime, with little attention by the Government to reducing the commodity control list to manageable levels, and thereby reducing the diffusion of technology to controlled countries. Now the U.S. export control system, and COCOM itself, are in the midst of a substantial reform effort.

On behalf of our industry, I can only say that we hoppe this reform is significant, and that it reflects the realities of the global market base, and potentially a reduced threat to our national security.

Controls need to be significantly relaxed, with only the most critical technologies being controlled, and then only to our true adversaries, not free world countries. Unilateral U.S. export controls on reexports and technical data need to be eliminated. The Government, especially the executive branch and the Department of Defense, must listen and be more responsive to industry.

This would be a role reversal over the highly adversarial nature of private sector government interaction on this issue in the past. If this dialogue were to be more productive, it would be necessary for Congres to mandate export control reforms to the commodity control list, and the interagency process, which is only partially working. A truly streamlined and effective multilateral export control system would relieve our industry of the excessive cost of administration and the competitive disincentive U.S. export/reexport controls often place on our products.

In addition, a control list tied to the most advanced technology will allow our industry to lengthen product life cycles by selling older products no longer marketable or sellable in the West.

The U.S. electronics industry is in a state of transition. The semiconductor industry and its supportive equipment and material sector, faces stiff and severe competition from companies supported by national efforts to spur investment. Leadership in these technologies is vital to our national security and economic well being as well.

The U.S. needs to address these trends in the following WAYS. Refocus R&D expenditures to commercial civilian needs; reduce export controls and ensure they are multilateral in scope; spur investment by pragmatic and innovative tax policies, including investment tax credits and a strengthen and permanent R&D tax credit; and finally, the U.S. Government needs to reduce and finally eliminate the Federal deficit by prudent spending and realistic budgets.

Thank you. Senator GORE. Thank you very much.

As I mentioned, I want to ask each of you to very briefly offer any comments you might have on the testimony of the others on the panel.

Dr. White, do you have any comments on the other four statements you have heard?

Dr. WHITE. I think I have heard a lot of very interesting advice. And I will take it to heart.

Senator GORE. You are going to leave it at that. Okay.

Dr. Fuller.

Dr. FULLER. The only thing I might add is that I generally would say that I agree and support the things that I have heard from the other panel members. I note the discussion you had with the gentleman from AEA you talked about the components being the areas of the industry being systems, components, and manufacturing equipment.

Senator GORE. And software.

Dr. FULLER. And I was just going to emphasize, as I look inside Digital and the other computer systems companies, the two other areas that we have large investments in are base system software groups and systems integration, or services. If you look at DEC, which has about 120,000 employees, and you look at the engineers within the company, slightly over half are in the software industries, which are not as capital intensive, and hence, have not been the focus of a lot of the comments on the board, but I think are critical to our computer system success in the future.

And there clearly are a set of troubling signs on the horizon. I would urge us not to neglect the software and systems integration side of the house as we try and rectify some of the problems we have had with the hardware and capital-intensive side.

Senator GORE. So you would say there are really five industry groups?

Dr. FULLER. Yes. And if you think of software in two groups, first there is the base system software which are really products that get put together with the hardware products that we sell to a customer. About a third of Digital's revenues come in the services area, which we classify as systems integration, software support, and hardware maintenance support. Those are largely software segments, and I think an important and growing part of our industry.

Senator GORE. Very good.

Mr. Mills, any comments on the others?

Mr. MILLS. The only comment I would make is on what Mr. Perrone pointed out, the erosion in the semiconductor infrastructure industry. And he pointed specifically to lithography as a great example of erosion. And I would echo that

and add that it really is even more pronounced than that. Lithography is the key process in the manufacturing process of semiconductors. And he described the market share erosion as 70 percent U.S., eroding to less than 40 percent in 1983.

If you look within that category to the critical component of lithography, which is stepper technology, it is even more pronounced than that in the last 10 years.

Senator GORE. Do you agree with that, Mr. Perrone?

Mr. PERRONE. Certainly. It is almost total.

Mr. MILLS. Just about from nearly 100 percent some 10 years ago, to I would guess today it is at 10 percent. And SEMATECH is obviously working aggressively with two domestic manufacturers, GCA and SBGL, to reverse that trend.

Senator GORE. Do you think that it is clear the Japanese industry has a comprehensive plan?

Mr. MILLS. Absolutely. It is a very well thought out, very well executed plan. And it really began in 1975 with their VLSI program, where they had targeted our industry as a key strategic industry, and they have had the patience and the fortitude in government and in industry to allow that to play out.

Senator GORE. And they have set out systematically with a lot of capital, a lot of patience, and great effort, to completely dominate this industry which is so important to the future of the world economy, and was pioneered and developed here in the United States.

Mr. MILLS. More than that, they have systematically gone after the critical components in the food chain that Mr. Kertzman pointed out. They have gone after the semiconductor components arena itself, the semiconductor infrastructure arena itself, and the real pay out is going to be computers and telecommunications.

Senator GORE. So when we first realized what was going on, we organized SEMATECH to respond to it.

Mr. MILLS. Well, you say first realized?

Senator GORE. Well, when the governmental system first got it through its corporate skull. When the Government first reached a sufficient level of agreement that this threat was real, SEMATECH was the first coherent effort by Government to develop a kind of plan of our own, and attempt a response to this Japanese effort, correct?

Mr. MILLS. There have been other initiatives, but this really is a unique experiment, SEMATECH, that is, in that it has, one, forged an alliance of the industry. Our 14 member companies represent more than 80 percent of the U.S. manufacturing capacity. And the public/private partnership aspect of this is certainly the first of its kind.

Senator GORE. So the taxpayers pumped a lot of money into this, and the industry pumped a lot of money into it, and SEMATECH identified the key technologies that needed to be developed in order to strengthen the U.S. industry's response to the Japanese?

Mr. MILLS. That is correct.

Senator GORE. One of the successful efforts was Semi-Gas. The taxpayers put a lot of money into Semi-Gas. SEMATECH worked with them closely. You developed this critical technology to a point where you were two years ahead of the Japanese. And then the Japanese came in and said, well, we would like to buy this little company now that you have put all this taxpayer money into it and you have developed this new technology that we do not have yet. We agree with you, this is going to be one of the keys to the future of this industry, and we want it. We do not want you to have it. You are competing with us. We want it so we can

use it to beat you over the head and continue this strategy that we started back in 1975.

So SEMATECH goes to the administration and says, hey, wait a minute, you guys are not even going to dream of allowing this, are you. And President Bush said, oh, sure, okay, we will give it to them, taxpayer money and all.

With the exception of Mr. White, I have a question. I will come back to you in a minute, Mr. White, and I make this exception because I do not want to put you on the spot. I know you will attempt to answer a little differently anyway. Of the other four witnesses, do any of you believe that the way I am characterizing this is an overreaction? I want to try to characterize it correctly, both in terms of the substance and the tone.

Mr. Mills.

Mr. MILLS. I would like to point out that the process that has been identified for us to work these issues is the CFIUS process. And that is our sore point right now.

Senator GORE. Yes.

Mr. MILLS. As I mentioned, the process just does not work.

Senator GORE. Senator Hollings, among others, led the fight to include economic security in the mandate of CFIUS, so that it would look at economic security. And President Bush and the administration fought us every step of the way to prevent them from even considering economic security in reviewing the sale of key technologies to our foreign competition.

So it is not a surprise that the CFIUS process is flawed. We said it was flawed when it was set up. But, as you pointed out, they are empowered to look at national security. These technologies are critical to our future national security in the defense industries. And they did not even take that into account.

And is it true that CFIUS gave SEMATECH only 24 hours to prepare a case against this sale?

Mr. MILLS. I do not recall. I can say that it was very cumbersome to respond within the time frame. I do not recall that it was one day, but we did have some difficulty in responding within the time frame that we were required by the CFIUS committee to respond. But we did.

Senator GORE. Was there not a specific case where you were given one day to fly somebody back from the West Coast make that case?

Mr. MILLS. I believe that is correct. We had several one-day turnaround requests.

Senator GORE. I want to pursue this, and then I will recognize Senator Lott. I will pursue this for a couple of minutes longer.

I forestalled any opportunity for you, Mr. Perrone, or you, Dr. Fuller, or you, Mr. Kertzman, to offer a correction to my characterization of this. Am I off in the way I am characterizing this? Am I overreacting to this?

Mr. Kertzman?

Mr. KERTZMAN. In thinking about your reaction, I am looking for an analogy. I come from Boston, and whenever we look for something that can symbolize a tale of woe in an organization under siege we think of the Red Sox. [Laughter.]

Mr. KERTZMAN. There is a terrific book which I just finished called "The Curse of the Bambino" by Dan Shaunessy, a "Globe" sportswriter, that talks about how everything bad that has ever happened to the Red Sox can be traced back to the owner of the Red Sox, Harry Frazey, selling Babe Ruth to the Yankees for $100,000.

Senator GORE. Luckily George Steinbrenner was not with the Yankees then.

Mr. KERTZMAN. That is right. He would have been long gone by then anyway.

Naturally there has been a great deal of outrage on that, and my feeling is that our electronics industry by actions like this stands the risk of becoming, in effect, the farm system to the big leagues of electronics which exist overseas. We do have a farm system here in the U.S. It is our small entrepreneurial companies that bring to the marketplace the advanced technologies.

If we then take those developed players like Semi-Gas and sell them to a competitor, then that is just what we are going to be. We are going to continue to be a farm system. I think our feeling in the American Electronics Association is that that is bad for America. We do not want to be the farm system. We do not necessarily want to be the only league, but we want to be in the major leagues. The actions that we are taking will keep us out of the major leagues if we keep selling our seed corn, in effect, in our farm system.

Senator GORE. Well put.

Dr. Fuller.

Dr. FULLER. I would make just two comments, one on behalf of CSPP. We are in some sense the new kid on the block. We were formed recently, we have had just one report out, and I really believe it will be well toward the end of this year before CSPP as a body can come back and say whether you have overreacted or correctly reacted.

The second comment I would make on behalf of Digital. Digital is one of the strong supporters and original founders of SEMATECH. I think Mr. Mills has stated well the situation there, and I certainly would support all that he had to say.

Senator GORE. So you are also outraged by this

Dr. FULLER. Yes.

Senator GORE. I pulled one out on you.

Mr. Perrone.

Mr. PERRONE. I will not comment on whether you are overreacting, Senator. There are some similarities to a personal situation. We have been acquired by a large company, and at the time there were some Japanese companies that were interested in acquiring the company. We were about the same size at least in our semiconductor-related revenue as Semi-Gas. We are a wholly-owned subsidiary of a large multinational corporation.

The owners of those companies do not decide who the company is sold to. It is owned by the shareholders of the corporations, and the boards of directors of those companies decide. It is an investment decision which they are entitled to make because they put up the money to do it in the beginning. SEMI in and of itself was not involved and has no policy on the Semi-Gas issue.

On a personal basis, though, I can say that this is part of the hollowing out of the industry. This is what is happening. It runs both in that way where the Japanese come in and they will buy a U.S. company that they feel gives them a precompetitive stature in the marketplace. In other words, they can go anywhere they want and develop tools and equipment and materials that give them a competitive advantage since they have some infrastructure benefits that we do not have.

Third, what is now happening on the reverse side which I will add to the comments of my associates here on the panel is that now the Japanese, to avoid trade friction problems, in fact are investing heavily in the United States and building plants and facilities.

I can assure you that most of the companies that I know in the semiconductor equipment and materials infrastructure, which is at the bottom of this food chain that Mitchell described, never have an opportunity to participate in that business

despite the fact that they are now on U.S. soil. This is also part of the hollowing out process that we are seeing.

This is a large strategic issue for small companies like mine that do not get a chance to compete any longer even on home soil. So with this erosion of the base because the market share of our customers has declined, now we have a foreign competitor, heavily backed with good initiatives by its government and its private sector in close cooperation, further hollowing out the infrastructure.

Senator GORE. What if we went over to Japan and attempted to purchase a little high tech company that had developed a key breakthrough in this area? Why not just do that?

Mr. PERRONE. Forget it.

Senator GORE. You mean their government might not allow that?

Mr. PERRONE. That is right.

Senator GORE. They do not take the same approach as President Bush?

Mr. PERRONE. No, they do not.

Senator LOTT. Boone Pickens is working on that, though.

Mr. PERRONE. They do not take the same approach at all not just to the executive branch but the whole governmental process. It is totally different in how it supports civilian R&D to support the infrastructure and to increase the standard of living.

Senator GORE. Maybe everything will work out okay.

Mr. PERRONE. No, it probably will not, not in this industry.

Senator GORE. Dr. White, I am going to have questions for you and the rest of the panel on this and other subjects as well, but I am going to end this round of questioning for myself and recognize my friend and colleague, Senator Lott.

Senator LOTT. Thank you, Mr. Chairman. I want to thank this distinguished panel for being here this morning. I am sure that your statements have been very interesting, and I have reviewed them. I have just two or three questions.

First, I want to say I agree with the Chairman. I do think economic impact should be a consideration in denying these or making a decision on these foreign investments. I hope that we will move that way, and I will be glad to work with him in that regard.

Now this hearing was going to address the question of the competitive status of the U.S. electronics sector from materials to systems. There is a quote in an article I have here, I guess, from the "New York Times" that quotes a former president of SEMATECH, Mr. Noyce, to the effect that the alliance was on course to reclaim the lead from Japanese rivals by the mid 1990's.

Mr. Mills, do you agree with that?

Mr. MILLS. Yes. We feel that we are on target to hit our phase 3 goal, which was at that time to surpass Japan in world leadership position for manufacturing capability of semiconductors.

Senator LOTT. Does that sort of go in a direction contrary to the tone of what is being said here when you talk about a hollow area and problems and yet saying that we are on track to achieve this by the mid 1990's?

Mr. MILLS. I say we are on target. I do not say it is easy to maintain that course. The difficulty we have, the most timely example, which is why I was asked to come here today, is this most recent sale of Semi-Gas. It is a great example of how difficult that course can be to achieve that end.

We will make up for this setback and others that we have had along the way in some way, shape or fashion because we think we are creative, aggressive folks.

Senator LOTT. Are the lights going out? It is worse than I thought it was.

Mr. MILLS. It is everywhere.

Senator LOTT. Let me say that I want to commend the panel for your statements. Just quickly looking over them, the thing I like about it is most of you make some specific positive recommendations as to what you think we should and could be doing. That is unusual. Usually we get statements saying they have these terrible problems with no specific recommendations.

Mr. Kertzman, I would like to focus on yours in particular. At the end of your statement you have some SPECIFICS. promote the commercialization of technology; provide for multiyear authorization bill and adequate funding for the National Institute of Standards and Technology and its advanced technology program.

Would you like to expand on that? Are you talking about three years? What is adequate funding?

Mr. KERTZMAN. More than we have. More than they have is adequate. We have made recommendations——

Senator LOTT. You feel that the Institute of Standards and Technology is very important?

Mr. KERTZMAN. We do feel it is very important. I would say based on your question of SEMATECH and the progress it is making, I think we now have a terrific example of a successful joint venture between government and industry that is working. We think that the National Institute of Standards and Technology is the correct vehicle for such ventures on the commercial side of technology.

Senator LOTT. Now you also recommend providing for a strong education and research infrastructure, and in that connection you recommend that we double the National Science Foundation's budget.

Now NSF does not have a perfect record over many years, and a lot of their money winds up in the behavioral sciences and other areas of highly questionable origin. I realize that is a small area, and I think they have sort of turned that around in recent years. I do not know that doubling the NSF budget as a whole would solve your problem.

Now would you like to narrow that down and maybe say double their budget in a specific area?

Mr. KERTZMAN. I must confess that I am unfamiliar with the budgetary mechanisms of NSF and if their budgets can be earmarked for specific projects. We are naturally interested in technology related to electronics.

Senator LOTT. Congress does that all the time. The administration does not like it.

Mr. KERTZMAN. The other side of this, of course, is that no single remedy, whether they are on the list that I have recommended or any other, is adequate in and of itself to address the competitive needs of the American industry and the American electronics industry.

Senator LOTT. I happen to be a big fan of capital gains tax rate reductions. You make specific reference to that in your statement. Do you want to expand at length on that?

Mr. KERTZMAN. I will take you up on that one.

In fact, the number one problem we have in this country and competitiveness is the issue of cost and availability and, particularly, the patience of capital. CSPP has made that point. Near the top of its list of priorities is the issue of capital investments.

No matter what SEMATECH does in terms of the advances that SEMATECH makes in technology, if American companies do not have a competitive capital structure with which it can apply the technology that SEMATECH brings out and bring those to commercial markets, then SEMATECH's advances will go to foreign competitors.

To that extent, we believe that to address both the cost in particularly the patience of capital, the American financial community as well as individual investors need an incentive to take a long-term view of thier investments. We believe that the capital gains differential specifically targeted to equities which are producing investments is a key factor in bringing about patience capital.

Senator LOTT. With the objection that that would be benefitting the higher income level of society which would not be good.

My response is if we are interested in economic development and creating jobs and protecting jobs and being competitive, this is one of the key elements that we have to have to get it done.

Mr. KERTZMAN. I will preface this by saying that with all of those positions, I am a liberal Democrat from Massachusetts, so I have some sensitivity to the fairness issue. On the other hand, the answer I usually get to this is the Willie Sutton answer. When asked why he robbed banks, he said that is where the money is.

If you want to change the behavior of large amounts of capital in the U.S., then unfortunately you are going to need to influence the behavior of the people that have that capital. I would like to see a tax system that does an equitable job of treating all citizens fairly. On the other hand, if you want to achieve the end then you are going to have to influence the tax rolls.

Senator LOTT. That does not sound much like a liberal Democrat from Massachusetts.

Senator GORE. Would the Senator yield?

Senator LOTT. Sure.

Senator GORE. Do you think a capital gains differential is important enough to do it even if you had to raise the top rates in order to make up the revenue loss?

Senator LOTT. Careful, now.

Mr. KERTZMAN. Well, let me not give you the American Electronics Association position on this. I do not believe we have a formal position, and I am reluctant to characterize this as the association's position.

I personally believe that the answer to that is yes, and this is why. I am a funny kind of liberal Democrat from Massachusetts.

Senator GORE. Do you think Senator Lott will agree with you on that?

Mr. KERTZMAN. No, I doubt that.

Senator LOTT. You were doing so well.

Senator LOTT. Maybe we should move over for a moment to Mr. Perrone.

Did you want to get involved?

Mr. PERRONE. I would say to the argument about the capital gains provision being one which favors the higher compensated individual that even Mr. Sinai, who was never known for his move from the center to the right, has recently changed his stance.

I think his argument is a sound ONE. that, in fact, it creates a basis upon which more revenue comes into the government, which I think has been proven from the data; and secondarily, it will spur investment because currently we have not only in corporate America this quarter-to-quarter mentality but in the investment community we have a minute-to-minute mentality. I think the government needs to do some things to change that.

Senator GORE. If you would yield further just for a minute to make a serious comment, I have always supported a capital gains differential. I think we are making ourselves a Nation of day traders with no differential at all. The patience of the capital is what is important. I agree with Mr. Kertzman.

I do seriously believe that a potential area of compromise may not be accessible to all parts of the political spectrum, but I do seriously believe an area

of potential compromise would be to restore the differential and make up some of the revenue by raising the top individual rates. I sincerely believe that that is something that would be in the best interests of our country.

Senator LOTT. One last point. And Mr. Kertzman, I will give you another chance.

Mr. KERTZMAN. To see if I can rehabilitate myself.

Senator LOTT. You mentioned the GATT round. And I think it is very important that we do not come away from there a net loser. Do you want to comment on what you hope will come out of that?

Mr. KERTZMAN. What I hope will come out of that, particularly, is some progress on intellectual property. That is at risk now. I just got back from a trip with an AEA delegation to the European Community, to Brussels and to Geneva, and I met with our ambassador to the GATT, and I believe that the current problems in the agricultural sector are spilling over into every aspect of GATT negotiations. And the Europeans, I believe, particularly, are going to hold some technology issues in the GATT hostage to progress, from their point of view, or to our concessions, on agriculture.

Despite the fact that I would like to see progress on our issues, I would not like to see our Government back down, in general, on our principles on free and open trade.

The other message, by the way, that I got, that I was asked to deliver to Congress about this, is that the issue of tariffs to some aspects of technology industries continue to be important, and that our negotiators at the GATT feel that the Congress is not interested in putting tariffs on the table because of political issues of some sectors of American industry that favor tariffs for their particular sector. The electronics industry would like to see tariffs on the table, because we think we have tariff problems. We will just put that into the political mix.

Senator LOTT. Thank you, Mr. Chairman. I appreciate this opportunity. These were very interesting statements.

Thank you.

Senator GORE. Thank you.

Dr. White, the administration's view is that more vertical integration is the key to success in this area. Is that fair?

Dr. WHITE. I think it is certainly my position and one of the objectives that we have within the Commerce Department is to try to create, if you like, some kind of element of artificial vertical integration by bringing together the elements of the food chain that have been referred to here this morning, and to try to encourage them to work together to understand their collective objectives, and to try to cooperate in achieving those.

Senator GORE. Well, is it not going to be a lot more difficult to create these bigger structures, formally or informally, if the building blocks out of which they are to be created cease to exist as American-owned firms?

Dr. WHITE. That certainly would be true. And I think that is part of the reason for trying to have the industry have the vertical elements of the industry starting to communicate with one another. And if you look, for example, at the supercomputer industry, what we would like to try to do is to bring, as you say, the semiconductor people together with the supercomputer developers, with the supercomputer users, to make them aware of possible weaknesses in the system. So that we do not get into the situation that we are referring to today, where you have one data respond to a situation because it is suddenly critical.

If we would have had this food chain integration dialogue underway, we would be able to identify the fact that there is perhaps one supplier in the chain

that now has become critical. How did we allow Semi-Gas to become the 50 percent market share owner there and become so critical without us knowing that?

Senator GORE. Well, maybe you should call Craig Fields for an explanation of that. He is still around somewhere I believe.

Mr. MILLS. At MCC.

Senator GORE. At MCC. I know, I just talked with recently.

Dr. White, the way the administration reviewed this proposed purchase of Semi-Gas by the Japanese bothers me a great deal as you may have noticed, or as you may have gathered. The Japanese will pay $23 million to buy technology in which the U.S. taxpayers have invested heavily as part of our strategy to compete with the Japanese. It is going to cost SEMATECH six months and up to $100 million, $50 million of which will come from the taxpayers if the cost is that high, in order to create replacement technology, which will be of less value because it will no longer be two years ahead of what the Japanese have, because we will have allowed them to buy what we developed.

Moreover, SEMATECH is sponsored by the Department of Defense and is a project with major national security implications. I know that the Commerce Department does not always agree with the Treasury officials who run the Committee on Foreign Investment in the U.S., or CFIUS, but I want to ask you about this decision. Given that CFIUS is supposed to review the national security implications of proposed foreign purchases, is it not odd, I repeat, is it not odd that this group apparently thought nothing of undercutting a major DOD-sponsored research project?

Dr. WHITE. I think the process, as Peter pointed out, has a lot to be done to clarify issues such as national security. I think that the act under which the President can deny a purchase like this specifically says "very clear evidence that it endangers national security." And I think as you, yourself, pointed out, that has not been defined. And I think, within the administration, as you say, there is dialogue as to where and how you define national security.

Senator LOTT. May I ask a question right on that point.

Senator GORE. Okay. I can hear his wheels turning: How much do I really like this job?

Senator LOTT. Well, it is defense. It is not his area. He is in the technology area, not the policy and the politics.

Senator GORE. He has got common sense, and a lot of other people do not.

Senator LOTT. Would any of the panel members like to defend that decision to allow that to go ahead?

Mr. PERRONE. I will on a personal basis, Senator, but not speaking for SEMI, since SEMI does not have a position on it. But SEMI does have a position on spurring foreign investment. We are not opposed to it, since in fact investment money does come from outside the United States, and our foreign competitors and their governments invest in the United States in financing our own deficit to run the government and the services that it provides to the taxpayer, I do not disagree with that either.

So fundamentally I cannot disagree with the decision by the owner of that company.

Now if in fact SEMATECH did not put in place a strong confidentiality agreement, which I believe exists, right, Peter?

Mr. MILLS. Yes.

Mr. PERRONE. There is a strong confidentiality agreement which exists between Semi-Gas and what it did for SEMATECH. So unless they do not abide by that confidentiality agreement, then you can go to court, because hopefully

that is a binding, legal document. Over time, that technology will diffuse to Nippon Sanso. Whether in fact Nippon Sanso, in that sector of the technology, trails by two years or more, I do not know. That is a SEMATECH estimate I would believe.

Is that right, Peter.

Mr. MILLS. Yes.

Senator GORE. Let me make another point on this, and put it in the form of a question here. The Treasury Department, not the Defense Department, announced that it has reached some kind of confidentiality agreement with Nippon Sanso to protect the secrets developed by SEMATECH under the sponsorship of the Defense Department, in cooperation with Semi-Gas. But the Treasury Department, in negotiating whatever this is with Nippon Sanso, never thought to consult with SEMATECH or the Department of Defense about the secrets that it is allegedly protecting.

Now that strikes me as really strange. Have you yet heard from the Treasury Department, Mr. Mills, about what this confidentiality agreement is?

Mr. MILLS. No.

Senator GORE. You just have to rely on the newspapers to find out about it, right?

Mr. MILLS. The "Wall Street Journal" is a great source of information, yes, Senator.

I would like to point out, Mr. Chairman, in response to Mr. Perrone's comments, SEMATECH is time driven. And while, yes, you bet we have confidentiality agreements with every one of our partners that supply us with critical equipment and materials, I would submit that pursuing that protection in a court of law is not an ideal scenario when you are time driven, not profit driven.

Senator GORE. All right. To the best of your knowledge, did the Committee on Foreign Investment in the United States make any effort at all to give Semi-Gas's employees or management group more time to raise the additional $5 million that it needed to match the Nippon Sanso bid?

Mr. MILLS. I do not believe so. And this points out one of the flaws in the process. As I pointed out in my testimony, the process does not involve a mechanism for advanced warning. So, basically, the committee is in a responsive mode; it is in a reactive mode. And what we were seeking was ultimately to block the sale. But if the sale was not to be blocked, we were seeking time to develop domestic alternatives, including time to develop that management buyout proposal.

It also should be pointed out that that buyout proposal was a very adequate proposal. Three years ago Hercules purchased Semi-Gas and now three years later the proposals that I am aware of, the management-led buyout and Nippon Sanso's, were a three-fold increase in Hercules' original investment, and a four-fold increase. And I cannot blame Hercules for going for the premium. But, to me, a three-fold increase put on the table by management in a three-year period is a very adequate bid.

Senator GORE. Well, we are certainly going to take what you say about the changes needed in CFIUS very, very seriously.

Mr. White, were you or your colleagues at the Commerce Department consulted by CFIUS during its deliberations?

Dr. WHITE. Yes. Within Commerce, the Assistant Secretary for Trade Development is the one who represents Commerce on the CFIUS panel. And there are representatives of the various parts of Commerce, including the Technology Administration, that provide input to Commerce's position. And the Technology Administration was consulted.

Senator GORE. Is it fair to say that with the Commerce Department, it is the trade guys that handle the CFIUS account?

Dr. WHITE. That is there responsibility.

Senator GORE. Were you personally consulted during this deliberation?

Dr. WHITE. Yes. I was involved, again, at the very end.

Senator GORE. At the very end. Okay.

Do you know about this confidentiality pact between the Treasury Department and Nippon Sanso to protect SEMATECH's secrets?

Dr. WHITE. No, I do not.

Senator GORE. When will the Justice Department's antitrust review be completed?

Mr. MILLS. I do not know that. Again, this whole process, whether it is CFIUS or Justice, as I mentioned, seems to be shrouded in rather unnecessary secrecy. I am not aware of where Justice is in its review in this case.

Senator GORE. Who within Justice has the line responsibility for this review?

Mr. MILLS. Oh, boy.

Senator GORE. You can supply that for the record, if you wish.

Mr. MILLS. Yes, I can get that. He is the head of the Antitrust Department.

Senator GORE. Just advise our subcommittee staff as soon as possible after the hearing on that.

Mr. MILLS. Will do.

Senator GORE. Is it true that if the purchase is approved, Nippon Sanso will gain between 50 and 75 percent of the world market in this key semiconductor production technology?

Mr. MILLS. Yes. We believe the worldwide market is the relevant market here, and you are absolutely correct.

Senator GORE. Do you know of any examples of Japanese equipment or materials producers slowing down the availability of new technologies to non-Japanese manufacturers?

Mr. MILLS. We have certainly heard of cases like that, and we have every reason to believe that they do it. I believe I offered in testimony to this Subcommittee several months ago such a case, where Nikon responded to a question about when their most state-of-the-art equipment would be made available to U.S. manufacturers, their response at a conference was, we will provide it when it is appropriate.

Senator GORE. Mr. Kertzman, did you want to comment on that?

Mr. KERTZMAN. Anecdotally, you know, I have heard a lot of stories related to such things, not necessarily in the materials and equipment area, but just in—DRAM memories, for example, when there are shortages, that domestic systems suppliers get priority in their allocations of DRAMS versus foreign competitors.

Senator GORE. It is part of their plan. Part of their plan.

Mr. KERTZMAN. Sure.

Senator GORE. Now, news reports have indicated that an administration official, I take it in the Treasury Department, said that Nippon Sanso as part of this agreement had agreed to sell to American chip-makers a different gas-purifying system preferred by many Japanese chip-makers because it reduces defects in the chip-making process. Do you know what that is?

Mr. MILLS. That is the first I have heard of it.

Senator GORE. Does anybody know what that is? [No response]

Senator GORE. Well, maybe the computer chip experts at the Treasury Department are real excited about something that you do not know anything about. They may have gotten a better deal than you know.

Mr. PERRONE. That is probably true. Senator, what it may be is that the Japanese do things a little bit differently. As a vendor to them, in our industry they do things differently than we do them here in the United States, and our European customers do. In other words, in the semiconductor industry. So they are probably talking about some other systematic methodology that they use in Japan which is different from what has been used at SEMATECH. I am sure that that is what they are talking about.

To diffuse the possible further problems with this transaction on a technology basis, especially since Semi-Gas is involved with SEMATECH.

Mr. MILLS. I think that is an appropriate guess. It is still the first I have heard of it.

Senator GORE. Okay. Now, Mr. White—Dr. White. I have been saying Mr. White. I know you are not sensitive about that.

Dr. White, you noted earlier that a question that does not receive sufficient attention in the wake of a purchase like this is, how do we get into a situation where this is the one company that has such a big share of this sub-market in the first place? Why are we in such a tenuous position, vulnerable to a key strategic take-over like the Japanese purchase of Semi-Gas?

Why do not American computer and semiconductor companies buy the Semi-Gas's of this Nation? Why do they not buy these firms so that they stay in American hands and our large companies do not become overly dependent on potentially unreliable foreign sources?

Obviously, the cost of capital here is one of the key factors. I think everybody on the panel is agreed on that. Does anybody disagree? [No response]

Senator GORE. I think that this Subcommittee certainly has many members who agree strongly with that. I agree with it. Are there other factors that you would like to highlight in your response, Dr. White?

Dr. WHITE. No. I think that is a major one. I would imagine just the cost of capital.

Senator GORE. Now, secondly, why do our companies apparently lag so badly in manufacturing? I have got an American lap-top computer that I use all the time, but it all has three American-made parts to it—the microprocessor, the disk drive and the label.

Mr. PERRONE. A lot of that disk drive was not made here, Senator.

Senator GORE. Some of the components of the disk drive were not made in the United States. They are not made here either, are they?

Mr. PERRONE. No.

Senator GORE. That is a deceptively large question. Why do we lag so badly in manufacturing? Can you give a concise answer?

Dr. WHITE. No. I do not think there is an easy answer to that. I think I referred in my testimony to the fact that our manufacturing process in America really operates on quite a different paradigm than our competitors, for example, and I think that arises out of the fact that our system was developed at the turn of the century for an environment that is no longer valid.

As a result, we find that at that time the idea was to break tasks down into various specific objectives and assign people those tasks to make sure that they stayed on those tasks, and it built a rigidity into the system and a lack of flexibility. Whereas the thing today is flexibility, to give the workers more authority in the whole process to make them aware of the whole manufacturing process so that they understand the objective. If we could adopt that paradigm, then we could introduce the tools that are available today, the computer-aided tools.

I mean, you find that in Japan most of the machine tools, 30 percent are computer-controlled, whereas we only have about 10 percent in the United

States, and if you talk to people in the manufacturing sector, they will often say they do not have the people who can handle that. They are not ready for that.

So I think it is a very deep problem, and I think it is a very important problem. It is not just a matter of putting computers into the hands of people, but it is a matter of changing the system. I think as a result of that, because that is so difficult, my feeling—my experience has been that American industry, when faced with trying to compete, as products begin to become consumer-like, they back away from that.

When the disk drive industry first began, it was attractive, it was high tech. But as you started to make more and more of them, and it became more and more consumer-like, we found American companies backing away from that.

Senator GORE. Government policy, as we have noted here, is a big factor as well. Your Department's own report on electronics makes two statements that I would like to highlight. First, and I quote, "If current relevant growth rates continue, the Japanese will be the world's Number 1 electronics producer and trader by the early 1990's." It is 1990 now.

Second, and again I quote, "In contrast to foreign Governments, the U.S. Government has not had a coordinated set of policies directed at this sector. In general, the United States has followed an ad hoc approach the effect of which has been to place the U.S. electronics sector at a competitive disadvantage vis-a-vis some of its foreign competitors."

You agree with both of those statements, do you not, that come out of your own Department?

Dr. WHITE. Yes. I think in some sense it is not so much a lack of policy on our part as it is the existence of many policies and strong policies on the part of our competitors.

Senator GORE. "The U.S. Government has not had a coordinated set of policies directed at this sector. In general, the United States has followed an ad hoc approach the effect of which has been to place the U.S. electronics sector at a competitive disadvantage vis-a-vis some of its foreign competitors." OMB must have missed that one.

Dr. WHITE. I agree.

Senator GORE. What role are you going to play in dealing with these problems? Are you in Commerce able to serve as a catalyst for getting both industry and Government to grapple with these issues, or are your hands tied?

Dr. WHITE. No. As I indicated, I think that we have a lot of ways in which we can approach this problem. My feeling is that there is an enormous inertia and strength in the American system, and that if we can get it focused in the right areas, if we can catalyze some things—for example, as Sam Fuller pointed out——

Senator GORE. Now, wait a minute. We have a lot of ways to deal with this problem. Is that what you said?

Dr. WHITE. I am saying that within Commerce we have quite a number of techniques that we can apply to deal with this problem.

Senator GORE. Okay, let us starting naming them. What is the first one you would name?

Dr. WHITE. We are doing internal R&D within the National Institutes of Standards in Technology, particularly related to the standards process itself, metrology. We are the world leader in metrology, in providing measurements technology to American industry. As you know, we also have the ability to award R&D grants to industry now through the advanced technology program.

Senator GORE. What is the budget in that?

Dr. WHITE. For 1990, it is $10 million.

Senator GORE. Really. Okay, go ahead.

Dr. WHITE. We have an advanced manufacturing effort that has a number of parts to it. One of them is to establish advanced technology centers throughout the country, and hopefully these will become, if you like, a nucleating point for polarizing the small and medium manufacturing operations in those regional areas. It becomes a vehicle for us to communicate and make people aware of the manufacturing technologies that are now available to them.

Many small manufacturing companies do not have——

Senator GORE. Let me just note that I am optimistic about that. As you know, I have personally put in the amendment for that, Before my intervention the budget for that was a little less than $1 million.

Dr. WHITE. You are now back with the advanced technology program?

Senator GORE. Right, the advanced manufacturing program. But I am optimistic about that. I was looking for the chart that was up on the easel earlier. You know, internal R&D within the Department of Commerce was not identified as one of the strong leveraging factors in U.S.—and I do not want to sound sarcastic, but I appreciate the strategies and techniques you are outlining here, but with all due respect to the administration—I am sorry. Actually, it does show up as a medium factor under "Applied R&D."

But with all due respect to the administration, we are in need of leadership in this area. I would be very comfortable, Dr. White, if they would just listen to you and if you could design the response. They will not, however, because President Bush and others closely advising him have a wildly unrealistic view of what this competition is all about.

As I said earlier a couple of times, I genuinely believe that he is frightened of offending the Japanese. His approach to Japanese technology policy is the same as his approach to Chinese human rights policy. He is scared to offend. He is scared to take a risk that they will be unhappy and displeased with him. His advisers make sure that they give the Japanese a free shot at picking off U.S. technology even when it is developed with U.S. taxpayer subsidies.

I welcome the initiatives that you have been able to get past the OMB over there, but, again, they are just minor in impact. I hope I am wrong about that. I hope some of them will grow to be major in impact. Realistically looking at them, however, it is not likely that they will make much of a difference against this kind of onslaught that we have here.

Let us say for example that the advanced manufacturing initiative results in a dozen new start-up companies just like Semi-Gas to develop dramatic new advances that will strengthen American industry. Just as soon as they get something that is world class, you know what is going to happen, do you not? The Japanese are going to come and buy up the companies to get the technology.

So while I am optimistic about that initiative, I am tempering my optimism with what I think is a realistic view of the attitude of the administration on this.

There are a lot of other questions I would like to pursue. We cannot do them all today, but I am going to pursue a few more. I will have several questions for the record in the area we have just been pursuing, but let me ask a few questions about the structure of the American electronics industry and the question of how the American electronics industry is organized and the relationship between computer companies and their suppliers in particular.

You all may have seen Charles Ferguson's recent article in the Harvard Business Review arguing that many American electronics companies are too small and undercapitalized to survive in a business characterized by rising development costs and the large foreign competitors. He calls for American companies to form alliances with each other and with European firms, especially

vertical linkages. He calls for Americans to form their own version of Japan's famous keiretsu.

Putting on your old hat, Dr. White, as an industry executive, what do you think of that idea? Do you think that larger electronics companies now see it to their advantage to work closely with smaller American firms; if not, why are they reluctant to do that?

Dr. WHITE. I think that part of the key to improving quality is to have strong relationships with your suppliers and vendors, and I think that that is the first thing that a company generally tries to do when it is moving into a manufacturing arena. I think that having those kind of relationships and alliances is a very valuable thing.

I do not think that we want to go to the extreme of a keiretsu where people are, I think, rather rigidly locked into a system.

Senator GORE. Do you think that these alliances, whether as strong as a keiretsu or informal in nature as you have discussed would strengthen the U.S. electronics industry?

Dr. WHITE. I think so.

Senator GORE. Does anybody else want to comment on that

Dr. FULLER. I would make a comment, Senator, as well. I have read Ferguson's recent article. I have also talked with him about some of the earlier work he has done over the past three years.

I think it is useful to take a look at his work over the last couple of years. I agree with Dr. White that there are these alliances, formal and informal, being developed through Digital as well as all the other principal companies here.

Another thing that Ferguson points out over the past couple of years that I think is important to see is that there has been a tendency in the United States for some of these smaller firms as they have done well to in fact, as they get acquired by the U.S. or Japanese firms, lose their competitiveness and then move on to their small company or their next enterprise. Somehow I think you need to go back to that piece of the American culture.

One of the things that often is brought to my mind is that there are not a lot of successful acquisitions in the computer industry. I have just now looked down the list of 11 computer firms that are part of CSPP. None of them have grown to their size through acquisition. Most of them have been formed within the last 30 to 35 years and have fortunately not been bought out by the Japanese or Europeans, and there was the patience for them to grow to the size they are now.

So there is something that I think is worth looking at and on which Ferguson has done quite a bit of research. As you look at the American enterprise and these small entrepreneurial firms that arise, how do you in fact keep them healthy over multiple generations of technology and not have them have a sharp rise and then a sharp fall and then over time get overtaken by firms in Japan and elsewhere that have a more patient approach to the technology.

I do not believe that just having the large American firms acquire small firms like Semi-Gas is the answer. That has not worked well in the past.

Mr. PERRONE. Senator, that formula in acquiring smaller companies that are in the food chain infrastructure is almost a formula for failure. We cannot do it in the way we are structured industrially and culturally like the Japanese can. They undercapitalize those small divisions that they acquire.

In fact, we use a competitor in Japan to distribute our products. He is undercapitalized. It makes no difference there. In the United States it makes a big difference if you are undercapitalized because then you just cannot get a return on equity to your corporate parent that makes it worthwhile for them to sustain that operation. So we have infrastructure problems inherent that prevent

us from doing that. There are lots of companies that have tried it, taking it down further from even, say, a Digital Equipment or an IBM acquiring a tool manufacturer. That has been tried a couple of times and has been unsuccessful and probably will be in the future.

Senator GORE. Mr. Kertzman.

Mr. KERTZMAN. I think that the keiretsu model, first of all, even in Japan does not always involve total ownership, so it is possible through minority equity investments, long-term supply relationships, et cetera, to achieve some of this.

One thing I think, however, that the Japanese have done to undermine our ability to do this and to work together if it threatens it is we saw as an example when the semiconductor industry came under attack and went to our government for help, it came up with the now famous chip agreements. It set two aspects or two important sectors of our industry against each other. Our computer systems suppliers, who are users of semiconductors, based on the government action incurred much higher cost for semiconductor memory.

We are now seeing, I think, the early stages of a similar crisis in flat panel displays where the Japanese have targeted flat panel displays, and the flat panel industry has now come to the government with dumping complaints. I think the system suppliers again are users here.

I think there is a tremendous opportunity for the government, and I think the administration in particular underestimates the power of leadership in this area. I believe that there is an appropriate role here for the government and preferably the President to, for instance, sit down with executives from both sides on this and say it would be in the Nation's interest if we could keep our unity on this issue, if we did not set at each other in an important issue like this so we could avoid something happening as happened with the semiconductor agreement.

I believe, for example, that if the President had sat down with executives of that industry and said that something like U.S. memories would be in the national interest that U.S. memories would have happened. Sandy Kane has said similar things.

I agree with what you are saying and with what Ferguson says about the importance of these kind of relationships and of larger economic structures, but our foreign competitors are trying to undermine our ability to do that, and we need to find a way with the government's help to sit down at the table and talk to each other and find a way to work together.

Senator GORE. Does anybody know whether or not Dr. Bromley was advised of the Semi-Gas problem? Did he have a chance to participate in this?

Do you know, Dr. White?

Dr. WHITE. His office was informed of what was going on.

Senator GORE. I know that in the past he has offered some leadership in this area. I just wonder if he went along with this.

Dr. WHITE. I do not know.

Senator GORE. I would really be surprised if he did. I have not had a chance to talk with him about it. I just wondered.

I agree with you, Mr. Kertzman, that this administration underestimates the power of leadership. I would broaden that to say they underestimate the significance of leadership in most things except flag burning, for example. He really came down hard on that.

He could have called the president of Hercules, for example. That might well have made a difference; given an additional week for the buyout group to come up with the extra $5 million. This would have been easy to prevent. Now the taxpayer-subsidized consortium is going to have to come up with maybe an extra $100 million to undo the damage, and the damage will still not be undone.

It really does call into question, also, our ability as a country to make the consortium approach successful. I am a great believer in SEMATECH, but if the rest of the government is going to actively undermine SEMATECH and hurt SEMATECH, refuse to listen to SEMATECH, refuse to consult with SEMATECH, refuse to give SEMATECH a chance to protect itself against a hostile effort by the Japanese to harm SEMATECH, then how can we have confidence as a country that we can make a consortium approach like this work?

I think SEMATECH will prevail even against these odds, but it is tough for them to have to fight not only the Japanese but President Bush, also. You know, we have two consortiums. We have SEMATECH, and we have President Bush and the Japanese in this case working hand in hand here.

Now Mr. Perrone, you mentioned Moshe Lubin's proposal to create test-bed projects. He made that proposal here at a hearing we had on May 17 on the semiconductor industry.

As I understand his idea, he says that buying new manufacturing equipment is often a long, expensive and risky business for semiconductor firms. To lower the cost and speed the introduction of new equipment, he proposes one or more test bed projects jointly funded by equipment firms, semiconductor companies and the Federal Government. Instead of developing their own new equipment, these projects would test and refine equipment created by innovative small firms and help qualify the best pieces of equipment for use by the chip makers.

In Lubin's words, the test-bed program would burn in new tools and make them worthy for production on the factory floor. SEMATECH, in fact, has already begun to do something like this, but Lubin would extend the idea to new generations of equipment.

Have you had a chance to review this idea? If so, what is your general reaction? Is it worth exploring as a way to cut both the costs and time involved in getting new equipment to American semiconductor companies?

Mr. PERRONE. The answer is yes to the first part of your question. I have explored it. The answer to the second part is yes also. One of the problems we have in U.S. industry is the need to move technology quickly into production, except that we do not have patient sources of capital to do that, and we have impatient customers. And I do not blame customers being impatient.

So, many times we will take what is a developmental product and put it into production, which I think is part of the problem that the U.S. infrastructure has. The Japanese are much more patient with that process. They will continue to refine better understood processes and products continually. And only when everything, or pretty much everything, has been defined and the process is very robust will they then put it into production. And I think SEMATECH is doing that. It cannot do everything because it is a very small project overall.

There are companies within the industry in the United States, and they are not the largest, because the Japanese companies are, who spend more money on research and development than SEMATECH does. Nonetheless, I think Hampshire Instruments' proposal, Mr. Lubin's, is a good one. And in fact it will work, assuming that triangle coordinates that development. If it does not, then we will, for the lack of private laboratories to do such things and the additional funding put into the program by the Government.

And it does not necessarily have to be all the Federal Government. The state and local governments are more than willing to participate in these kind of programs to get the manufacturing base and create the jobs that will result if we can successfully commercialize these technologies.

So he has one in place already at Livermore that was just announced last week, as a matter of fact, in lithography.

Senator GORE. Well, also, Oak Ridge is going to be involved in a similar effort with high-precision machine tooling. And, Dr. White, I know what your personal views are, but I take it that the Commerce Department could support an initiative like this?

Dr. WHITE. Yes, absolutely. We do have a consortium of about 23 companies working with NIST, for which NIST acts as a test bed for the testing of standards in manufacturing for transferring data between design and manufacturing capabilities.

Senator GORE. Incidentally, as an aside, this high-capacity fiber optic network that I have advocated for quite some time and that you referred to, Mr. Kertzman, could in fact make possible closer collaboration between vertically integrated groups of companies by facilitating the transfer of data sets from CAD/CAM terminals to numerically-operated machines, the transfer of modifications in digital blueprints from the systems integrator to the supplier, and in other similar ways. And it would enhance the ability of companies based domestically to enter into such collaborations, compared to collaborations with companies located overseas.

You do not disagree with that, do you? It is a self-serving statement in support of the proposal that is pending on the floor of the Senate, but I believe that is the case.

Dr. Fuller, let me again compliment you and your colleagues from the Computer Systems Policy Project for your valuable study, which sheds so much light on which factors determine whether or not American firms stay competitive in these key computer technologies.

I have just a couple of questions about your findings. If capital investment is a critical factor in the hardware technologies, and if, as we know, capital costs are much higher in the United States than in Japan, then is it correct to say that the high U.S. capital costs are a major reason why the U.S. seems to lag behind Japan in many areas of hardware?

Dr. FULLER. The simple answer for that is yes. I mean our interest in things like U.S. Memories that did not get off the ground a year ago, or our attempts to try and find some way to share the capital costs given the problems in the U.S. to get those off the ground. So the short answer is yes.

Senator GORE. I had other questions on Semi-Gas here, but I will ask them for the record. [The information referred to FOLLOWS.] Dr. FULLER. Senator, other thing I might mention on the capital investment. It was not on the chart we described, but we talked about the investment. We talked about infrastructure there as well, and you just mentioned the high-speed fiberoptic network. We have talked about building such a national digital infrastructure.

All of us on this committee have seen some real advantages to that. And one analog that I think is worth looking at, as you look back at the original papers of the ARPA network back in the early 1970's, and if you said, well, why would that be important for U.S. industry. And there were numbers of reasons elicited, sending files or sending code back and forth. The reality is, it turned out to be electronic mail, and it enhanced collaboration between the research labs and industry.

Senator GORE. And electronic mail did not even exist before ARPA net was put in.

Dr. FULLER. Right. And in the early years that it existed, people pushed it aside as saying gee, that is really not a major use of this network. I think likewise, once you put gigabit networks in place in the country, we will find applications for them that are hard to articulate today, but will have just as important an impact on the country as the ARPA and digital networks did 10 and 15 years ago.

So, hopefully, as the report goes further, we will expand more in terms of capital investment for the infrastructure, to talk also about the national network.

Senator GORE. But, there again, the White House is too timid to actually endorse the network. Everybody who has looked at it agrees that it is a real opportunity.

Dr. FULLER. It is a real opportunity.

Senator GORE. Yogi Berra once said, what we have here is an insurmountable opportunity. But the White House cannot find the gumption to recommend any money for it. But I think we are going to pass it over their objections anyway.

Dr. Fuller, I appreciate your candor earlier in going a little bit farther than you probably wanted to in reacting to the Semi-Gas matter, but let me ask you a slightly different set of questions. Your company finds itself dependent at times on foreign sources for many chips and components.

Dr. FULLER. Right.

Senator GORE. Given that many Japanese chip and component makers also compete with you downstream in the market, does this foreign dependence bother you?

Dr. FULLER. Absolutely. And speaking for Digital now, rather than CSPP, we clearly have a strategy to doing all that we can to develop local sources of supply. So where the initial one-megabit and now four-megabit DRAMs would come from Japan, we have continued to work to develop domestic sources of supply.

So, yes, we worry about that continually.

Senator GORE. Your study makes predictions about America's likely prospects in a number of critical technologies, ranging from hardware components to software. Of all the projections that you made, which one or two alarms you the most?

Dr. FULLER. Well, probably the most alarming is the one that we have been talking about here today, which is in the VLSI equipment and fabrication technologies. The fact that they are capital intensive, the fact that we have now fallen behind, and it is difficult to see how we will regain that leadership. We are still making investments in SEMATECH, and we do all that we can to help them, but whether wee will succeed or not, at times you cannot be optimistic.

I think that is the most alarming. Without the ability to produce the chips, you cannot build the systems. Without the systems, you cannot build the software systems that provide our customers with solutions. So that, to me, is the most troublesome.

Senator GORE. Do you believe that the top executives of the companies which belong to the Computer Systems Policy Project will become more active in the search for both new corporate strategies and new government policies to keep your industry competitive?

Dr. FULLER. I think the whole reason they got together last fall was the realization that they have to do that.

Senator GORE. Well, they can make a huge difference if they do. And I hope that they will get more actively involved.

I know that your project has not yet finished writing its policy recommendations. And I will not ask you to discuss what might be proposed, but your study says on page 3 that areas of public policy that have a high impact on the industry include cost of capital and tax strategies, education, federal research, development, and manufacturing policies, and strategies.

In your personal judgment, asking here about federal R&D programs, speaking only as an individual, what two or three things would you list as things the Federal Government could do in the research area that would be most valuable

to companies such as yours if you had a way to influence the placement of limited federal research dollars?

Dr. FULLER. Let me give you two answers to that. One is, I think Eric Bloch as NSF has done an outstanding job with the creation of the engineering research centers and the science and technology centers. It is a way to get collaboration between industry and the universities. And I think we have got to find ways to in fact continue that and do more of that in the years ahead. So that was number one.

I think Eric Bloch has really done some innovative work in making NSF more effective. I think Senator Lott's question of where should NSF focus, I think Eric Bloch is doing the right set of focusing with those engineering centers.

Senator GORE. We are having a farewell hearing for him tomorrow.

Dr. FULLER. Find somebody as capable as Eric Bloch to replace him. He has made a big difference.

The second thing I would comment on is one of the inspirations I have on how the Federal Government can make a difference in research is how ARPA and then DARPA, in the late 1950's and early 1960's, put research plans in place, which I think resulted in creating the healthy computer industry that exists today.

Timesharing, networking, and work stations, all of those things happened because ARPA or DARPA put the funding in place to develop a set of university centers that are absolutely world class.

Senator GORE. We already had the farewell party for Craig Fields. [Laughter.]

Dr. FULLER. And I worked hard to hire him at MCC, so he can continue to do his good work.

But the challenge, then, since Bob White is now at Commerce, the hope is that Commerce could create a civilian DARPA. I think it would be excellent if we could do that. I would urge people, though, to take a serious look at the history in the early 1960's of how that got put together. I think there is a number of outstanding civil servants, the late Professor Lichlighter of MIT was one of those people.

When you look at the decisions they made, ARPA could have gone a number of different ways. The fact that it went the way it did, and the fact that a set of research centers got put in place are I think a credit to the vision those people had in the early 1960's. And I would like to see Dr. White and others in Commerce be able to do as outstanding a job in the 1990's as Lichlighter and others did in the 1960's.

Senator GORE. Well, let me say this. I have got a number of questions which I am going to pose for the record, and if you would be willing to respond for the record, that would be appreciated. And I assure you, I intend to read the responses carefully. Because this Subcommittee is extremely interested in following this subject very, very carefully. We are going to continue our close attention to this.

We have run out of time today. But I want to close by thanking all of you for your participation here. I think you have been very candid and extremely helpful in exploring these questions. We will continue to be in touch with you on these matters, and I hope that the administration will change its policy and begin to take these matters seriously.

Thank you very much.

The hearing is adjourned.

[Whereupon, at 12:12 p.m., the hearing was adjourned.]

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